Structure and Dynamics of the Thunderstorm

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MANY TEXTBOOKS OF METEOROLOGY AND PHYSICS contain diagrammatic representations of the structure and vertical circulation of a thunderstorm. They are based mainly on theoretical deductions as to the kind of thermodynamic engine the authors, from laboratory experience, think the thunderstorm should be. Until recently, no precise means of probing the storms to verify or modify the textbook picture was available. Numerous exploratory airplane flights into more or less violent convective clouds or storms had been made, but until the development of the uses of radar, it was impossible to tell where the aircraft were with respect to the storm at any given moment. Free meteorological balloons also had ascended haphazardly into thunderstorms, but again it was not possible to track them until the perfection of radio-direction finding.

Meteorologists knew there were things wrong with the textbook interpretation of the thunderstorm, so with the wartime development of radar and improvements in the art of blind flying, plans were made for a concentrated research program to find out what goes on inside the thunderstorm. Commercial and military aviation interests needed the knowledge for flight safety and all-weather flying programs. With the support of all the interested agencies, the U. S. Weather Bureau organized an intensive campaign of observation and measurement. The undertaking, which came to be known as the Thunderstorm Project, developed into the largest program ever directed at a single atmospheric phenomenon and became a joint project of the U. S. Air Force, the U. S. Navy, the National Advisory Committee for Aeronauties, and the U. S. Weather Bureau.

In the summer of 1946 the observations were carried out in Florida, then in the summer of 1947 a similar program was completed in Ohio. Since that time the analysis of the large amount of data collected has been performed by a group of government and other meteorologists at the University of Chicago, and a comprehensive report of the findings is now in press. It offers solutions of the problems of thunderstorm structure and dynamics which have puzzled meteorologists for years and contains much information of use in flight operations.

In the following paragraphs will be given a brief description of the project and a summary of some of the results.

System of Observations

Basically, the observation program was designed to obtain a complete description of the thunderstorm and to measure its intensity. The turbulence or bumpiness and the broad up-and-down motions of the air were considered the most important items to be investigated, but great stress also was laid on all measurable quantities that could give a clue to the vertical and horizontal air circulations and to the heat exchanges that drive these circulations and produce the rain. Lightning, which has been one of the main subjects of interest in many years of investigation by physicists and meteorologists, was considered to be of secondary importance, although arrangements were made for measurements of the cloud electricity.

In its main details the observation system consisted of the following:

1. Airplanes were used as probes to measure turbulence, updrafts and downdrafts, temperature, and electrical field, and to obtain visual data such as hydrometeors, cloud extent, etc. Northrup Black Widow night fighters (P-61's) were utilized, flown by some of the Air Force's most expert instrument pilots, who volunteered for the task. In a normal mission, five airplanes made simultaneous traverses through the thunderstorms at five different levels, namely, 5000 ft, 10,000 ft, 15,000 ft, 20,000 ft and 25,000 ft.

2. A surface micronetwork was established, consisting of 55 stations located one mile apart in Florida and two miles apart in Ohio. The stations were equipped with gust-recording anemometers and wind vanes, hygrothermograph, weighing rain gage and barograph. The clock speeds on these instruments were fast enough to permit a time resolution to nearly a minute in most cases. The stations were attended daily by observers who traveled through the network in jeeps.

3. In and around the surface micronetwork were set up six radiosonde balloon stations with radio-direction-finding equipment. Outside the network were four radar wind-finding stations, using small radar-

[1] The author directed the government's Thunderstorm Project, which was completed this summer.

target-bearing balloons. All these stations made simultaneous balloon releases from which could be obtained, in addition to temperature and humidity data, detailed information concerning the perturbed horizontal wind flow, especially the horizontal inflow and outflow, of the cumulonimbus cloud.

4. Long range radar was used to detect the development of thunderstorms, to select the storms for study, and to guide the pilots and the balloon releases. The airplanes carried transponder beacons by means of which they could be identified separately and traced on the radar 'scopes even when inside the cloud echoes. The pilots were vectored through the storms by the flight controller who, stationed at the ground radar 'scopes, could watch their movements in relation to the thunderclouds. Radar also was used to study the development, growth, movement, distribution, and dissipation of thunderstorms. In this connection, range-height-indicating radar was also employed, giving a vertical crosssection through the clouds and affording an opportunity to study the rates of vertical growth. All 'scopes were photographed every few seconds.

5. Time synchronization afforded the means by which all observations from airplanes, surface, balloon recordings, and radar could be tied together to give the instantaneous and progressive picture of the atmospheric processes.

Structure and Life Cycle

In the analysis of the airplane data it soon became apparent that in the usual large thunderstorm the pilot was encountering areas of strong turbulence, each surrounded by a narrow belt of smooth but cloud-filled air. Roscoe R. Braham, Jr., Thunderstorm Project analyst assigned to this problem, recognized these as distinct convection cells that had become more or less joined together or developed as appendages to an original "mother" cell. For example, a typical Florida thunderstorm that was studied was found to be 20 miles long and about 5 to 8 miles wide, and to have six recognizable cells within it. These were roughly oblong areas measuring 3 to 7 miles across. Between each cell the airplane, although still in heavy cloud, recorded a smooth portion having a width of about a mile or less.

An examination of the photographs of radar echoes returned by the thunderstorms through their life histories verfied the cellular structure by showing the fusion or growth of these cells occurring in much the same way as the growth of masses of certain kinds of bacteria. Where the cells were present over the surface micronetwork, they could also be identified in the rainfall pattern which, at any given moment, had a distribution corresponding to that of the cells. A separate rain maximum would appear under each cell. Other meteorological elements were found to fit the cellular pattern.

The cells were not all alike in structure. Some were found to consist of an updraft only; some had both updraft and downdraft, while others contained only a downdraft. These differences were found to be associated with different stages in the development and dissipation of the cells. From these studies, the life cycle of the thunderstorm cell was worked out, and it was immediately apparent that a thunderstorm usually contains cells in different stages of the life cycle. While every storm must be one-celled at the beginning, the simple unicellular type was found to be rare because its period as a solitary cell lasts only a few minutes after it has reached rainy, thundery conditions. Thus the textbook diagram of a thunderstorm, always unicellular, is misleading.

The life cycle of the cell naturally divides itself into three stages: the *cumulus stage*, the *mature stage*, and the *dissipating stage*.

Cumulus Stage

The first stage of the thunderstorm cell is the cumulus cloud, although only a few cumuli actually build into thunderstorm cells. During this stage two or three cumulus clouds may grow together into one cell whose diameter may be between one mile and five miles, and whose top usually does not initially exceed 15,000 feet.

The most important structural feature of the cumulus stage is the updraft prevailing throughout the entire cell, balanced by slow settling in the environment. As might be expected, the temperatures in appreciable updrafts are higher than in the environment at corresponding levels. The general updraft varies from only a few feet per second in small and weak cells and cells in earlier stages of deve'opment, to almost 100 feet per second in large well-developed cells.

In accordance with well-known precipitation theories, raindrop coalescence occurs when the cloud top has extended some distance above the freezing level. When the accumulation of water exceeds in amount and in drop size that which can be supported by the updraft, the drops begin to fall through the weaker portions of the updraft and the cell passes into the mature stage of development.

Mature Stage

In the mature stage the cell contains in the lower levels a pronounced downdraft adjacent to the updraft. The downdraft reaches downward from approximately 25,000 feet, and throughout the cell above that height the updraft continues. The rain at the

surface is associated mainly with the downdraft portion of the cell. The structure is shown in Fig. 1.

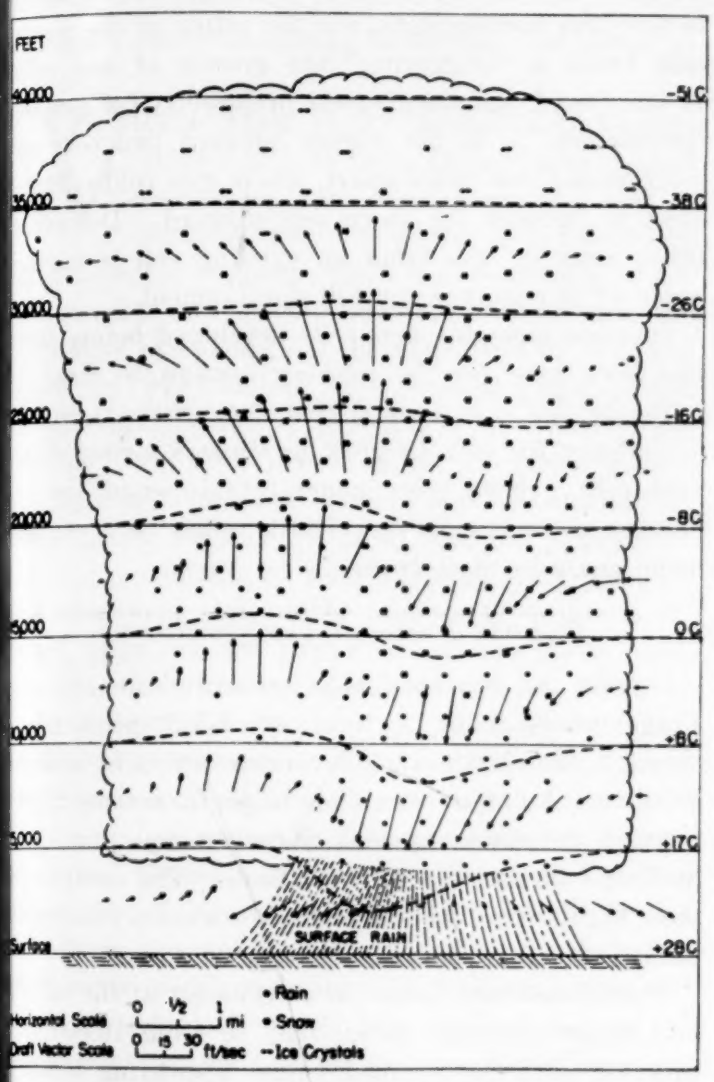

FIG. 1. Sketch of a vertical cross section through a thunderstorm cell in the mature stage, showing vectorially the air circulation. The temperature distribution shown is typical of summer thunderstorms in the eastern United States.

The downdraft results primarily from the presence of falling rain in an area of former updraft. The raindrops become so large and numerous that they exert a frictional drag on the air sufficient to change an updraft into a downdraft.

At this point in the description of the thunderstorm cell it is necessary to insert a few remarks concerning the thermodynamic processes. Classical treatments consider the ascending air from the point of view of the so-called "parcel method." In this process the rising air is regarded as changing its temperature with the expansion and water vapor condensation due to pressure decrease in such a way that it neither affects nor is affected by the environment air. In doing so, its temperature decrease follows the so-called wet-adiabatic rate. Laboratory experience and our atmospheric measurements show that the ascending air of the cumulus cloud behaves in much the same way as a vertical jet stream in the laboratory, in that it frictionally entrains part of the surrounding air. This means that air of less than saturation humidity comes into the cloud and mixes with the cloud air. In the active cumulus, there is enough liquid water being carried in the updraft to preserve saturation, in the face of intrusion of relatively dry air, without completely evaporating. That which evaporates in the mixing process loses part of the heat acquired in the cloud condensation process. As a consequence, the ascending air cools at a rate faster than the wet-adiabatic and at any point is very near the temperature of the environment.

When the frictional drag of the great mass of large raindrops finally changes the updraft to a downdraft, the descent involves increasing temperature at the wet-adiabatic rate, so the rate of warming in descent is less rapid than the cooling in the ascent. Mixing of outside air would tend to make the downdraft even colder, because of evaporation of raindrops. Thus the downdraft becomes a falling current of cold air which spreads out laterally as it strikes the ground.

All of the striking phenomena observed at the ground in thunderstorms are directly associated with the downdraft. Among them are the downpour of rain, the temperature discontinuity, the squall front or "first gust," the barograph "jump," the humidity "dip," and, to a considerable extent, the cloud-to-ground lightning discharge.

Either from the first gust of the wind that reaches out from the downdraft area or from air mass identification in terms of temperature, the outflow of the downdraft air can be traced with precision through the Florida and Ohio micronetworks. The data show that the cold air spreads outward almost equally in all directions in cases of gentle winds, but is carried downwind in a strongly diverging flow when the prevailing unperturbed winds are appreciable. A discontinuity is formed between the outflow air and the surrounding warm air. Although originally formed in the rainy portion of the cell, the downdraft air soon outruns the rain area and its arrival is felt at places several miles from the precipitating cell. The first blast of downdraft air experienced at a station is the strongest, but as long as the outflow continues, strong, gusty winds are observed. The strength of the first and succeeding gusts is less the farther the air has spread, being strongest near where the downdraft first reaches the ground in the early mature stage. There, and elsewhere, the wind speed and gustiness decrease with time as the spreading continues, except in those cases where a new adjacent cell reaches the mature or rain-producing stage.

Computations of the outflow made from a study of

the wind field as measured in the surface micronetwork show very pronounced patterns of horizontal divergence centers with the maximum values in the heaviest rain at the point where the downdraft appears to be concentrated. The simultaneous release of balloons at several points around individual storms having mature cells indicated outflow from the ground up to heights between 2000 and 5000 feet, with inflow above. This measured inflow provides a verification of the idea of entrainment of environment air into the vertically moving air of the cloud. In the later mature stage and in the dissipating stage, outflow was measured by the balloons at heights above 25,000 feet, corresponding to the anvil portion of the cloud.

In general, one may say that, heretofore, meteorologists have emphasized too much the thunderstorm updraft. The downdraft is by far the most striking feature, at least in the levels at or near the ground. The inflow winds that feed the updraft are mere zephyrs at the ground, while the outflow from the downdraft produces winds occasionally of destructive force. Other striking changes, such as the temperature drop and the pressure jump, go with the downdraft. Also it is evident that as a thermodynamic engine the thunderstorm does work both through the updraft, which is warmer than the environment, and through the downdraft, which is colder. Temperatures measured from the airplanes amply demonstrated these temperature differences and, in fact, showed that the stronger the draft the greater the temperature difference, in the sense indicated.

Dissipating Stage

When the downdraft has spread across the lower levels of the cell to such an extent that the updraft area becomes of secondary importance, the cell passes into the dissipating stage. As the process continues, the entire lower part of the cell has downdrafts, while in the higher levels there are negligible vertical motions. Slight downdrafts exist as long as light rain continues, although the entraining of environment air at this stage must be a contributing factor in drying up the cloud.

By the time the rain has stopped, large scale vertical motion has subsided and cell boundaries become very indistinct. The storm usually ends up as a dissipating layer of altostratus.

The Outflow and New Cells

One of the effects of the outflowing cold air which was immediately recognized and which was also known to previous investigators, was the action of the pseudo cold front in "triggering" the growth of new cells. It was found that the greatest probability for new cell development is in the region between two cells not more than three miles apart, where two cold outflows meet to squeeze the warm air upward. Downwind three miles or less from an existing cell is another place of importance for cell development.

In some cases the new cells developed before there had been time for the cold air outflow to make its influence felt. It seemed that frequently there was a tendency for cells to grow in clusters almost simultaneously. Some more general features of the dynamics of the air in the vicinity must be a contributing cause in these cases.

Flights Through Thunderstorms

During the two seasons of measurements, the Air Force pilots made a total of 1,363 penetrations through thunderstorms at various altitudes without accident. An effort was made to perform these flights through the most vigorous thunderstorms that could be found in the area of operations. The analysis of these flights furnishes valuable information concerning hazards in thunderstorms.

Turbulence was found to be greatest at the middle and upper altitudes flown, that is, from 10,000 feet upward, with the greatest values appearing between 15,000 and 20,000 feet. The least turbulence was found in the lower layers. Updrafts were strongest in the higher levels, as were also, to some extent, the downdrafts. The lightning and hail hazards were found to be greatest around 15,000 feet. In general the worst conditions were encountered at the altitudes at which modern airplanes with supercharged cabins are most frequently flown. The use of airborne radar to avoid thunderstorm centers of turbulence, particularly at these upper levels, was indicated to be desirable. With 10-cm radar, it was found that the turbulence outside the cloud echoes was negligible compared with that inside. The possibility of developing radar to the extent that the smooth areas between the cells can be followed should lead to a satisfactory solution of the thunderstorm flying problem at all levels.

A Method for Estimating Volume-Surface Ratios

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WITH THE CONTINUED DEVELOPMENT of cytochemical and histochemical techniques and their increasing use in research involving problems in pathology and microscopic anatomy, there is increasing need for more accurate and speedier methods of analyzing the quantitative morphological characteristics of cells and tissues. In 1943 Chalkley (*2*) proposed a new method for estimating volume percentages of morphologic components in fixed preparations, or under proper conditions, *in vivo*. This method depends on the fact that if points are thrown at random on a block of tissue the percentage of points lying in any morphologic component will, as the number of points is increased, approach the percentage of the tissue block accounted for by the individual component. Tests in several different laboratories (*1, 5, 6*) have confirmed the original expectation that the method would prove expeditious and accurate.

In the present paper an attempt is made to extend this method to obtain estimates of the volume-surface ratio of morphologic components such as cells or nuclei. There are good reasons *a priori* for believing that changes in this ratio may be correlated with different physiological states, but until a method of measurement is available no confirmation of this expectation is possible. The method to be proposed takes as its point of departure Crofton's remarkable results (*3*) showing that if an indefinitely long line be repeatedly placed at random over a plane containing a closed figure, the average length of the chord intercepted by the figure will be π area/perimeter, no matter what the shape of the figure, so long as it is not reentrant.

This result requires modifications in several respects before it can be used for the purpose at hand: a) it must be made applicable to lines of finite length; b) it must substitute some simple procedure for the laborious and inaccurate method of measuring chord length; c) it must be extended to cover reentrant figures; d) it must be extended to provide an estimate not merely of the area-perimeter ratio in the focal plane under observation but of the volume-surface ratio in three dimensions of which the observed focal plane is a two-dimensional sample.[1]

[1] A related problem has been considered by Wicksell (*8, 9*). If a large number of spherical or ellipsoidal corpuscles of different sizes are distributed in a body, split in two by a plane section, Wicksell expresses the distribution of the diameters of the corpuscles in the body in terms of the distribution of the measured diameters in the plane section.

The first three of these modifications are accomplished by a single simple device. If we use a line of finite length, say r, and count the number of times the two end points fall in the interior of a plane figure, denoted by h for hits, and the number of times the line intersects the perimeter of the figure, denoted by c for cuts, then in a very large number of throws $rh/c = \pi$ area/perimeter for all closed figures, including reentrant ones (Fig. 1). The fourth modification is provided by the mathematical result that, when a line of length r is placed at random in three-dimensional space containing a closed figure, in a very large number of throws $rh/c = 4$ volume/surface.

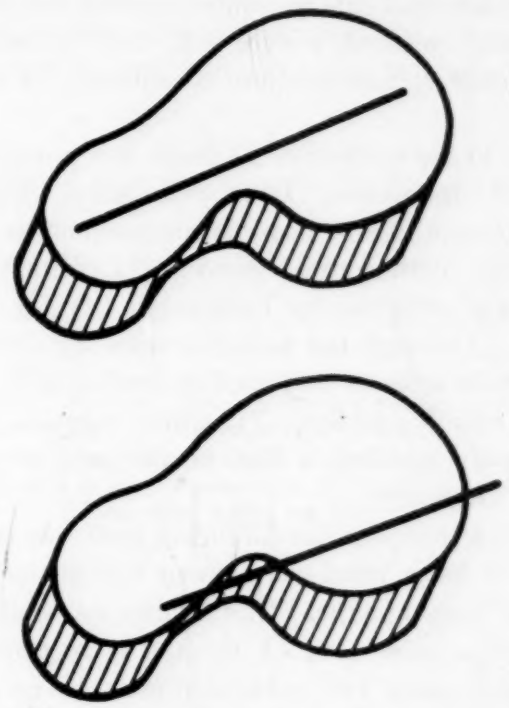

FIG. 1. Schematic representation of a randomly thrown line intersecting a closed three-dimensional figure. In the upper sketch the reading is two hits, no cuts; in the lower, 1 hit, 3 cuts.

This result satisfies condition *d*, since placing a line at random in three dimensions can be shown to be formally equivalent to placing a plane at random in three dimensions and placing the line at random on the resulting two-dimensional plane section.

If the space contains a series of figures of different volumes and surfaces, $rh/c = 4$ sum of volumes/sum of surfaces. As in two dimensions, this result applies whatever the shape of the figure, but covers reentrant as well as nonreentrant figures. Mathematical proofs are provided in a more complete discussion of this problem to be published elsewhere. It follows from this result that if a method can be found by which a

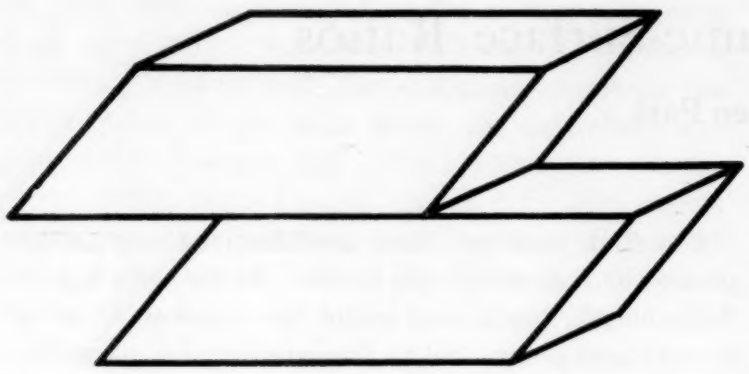

FIG. 2. Reentrant solid.

line of length r can be placed at random in a tissue and the hits and cuts on some specified morphological component counted, $\frac{1}{4}\ rh/c$ will yield an estimate of the average volume per unit of surface for that component.

Basic to the mathematical result is a particular definition of randomness. Other definitions, which lead to different results, are possible and cannot be excluded on purely mathematical grounds. Crofton's original result was criticized by Edgeworth (*4*) for this very reason. Although the definition used by Crofton and by us is the same as that used by Buffon in his solution of the needle problem (*7*), which solution has been empirically verified, a test of the method is nevertheless necessary.

For that purpose the following trial was conducted. Strips of balsa wood were sawed into geometrical figures of known shape. The figures we shall consider here are a cube $\frac{1}{2} \times \frac{1}{2} \times \frac{1}{2}$ in. and a reentrant figure found by taking two parallelepipeds $\frac{3}{4} \times \frac{1}{4} \times \frac{1}{4}$ in. and glueing one on top of the other to yield a figure of the shape shown in Fig. 2. The figures were dropped into a cardboard container filled with melted paraffin and talc and stirred. After cooling, the mixture was sliced into parallel sections, and all the resulting blocks were laid level, adjoining each other. Fig. 3 shows the resulting sections for the $\frac{1}{2} \times \frac{1}{2} \times \frac{1}{2}$-in. cubes. A needle was thrown onto the blocks 2000 times, and the number of hits and cuts made by the needle on the sections of the wooden blocks that appeared in the slices was recorded at each throw. After each 100 throws the sections were reshuffled. Fig. 4 shows the results for the cubes, Fig. 5 for the reentrant figure. In both

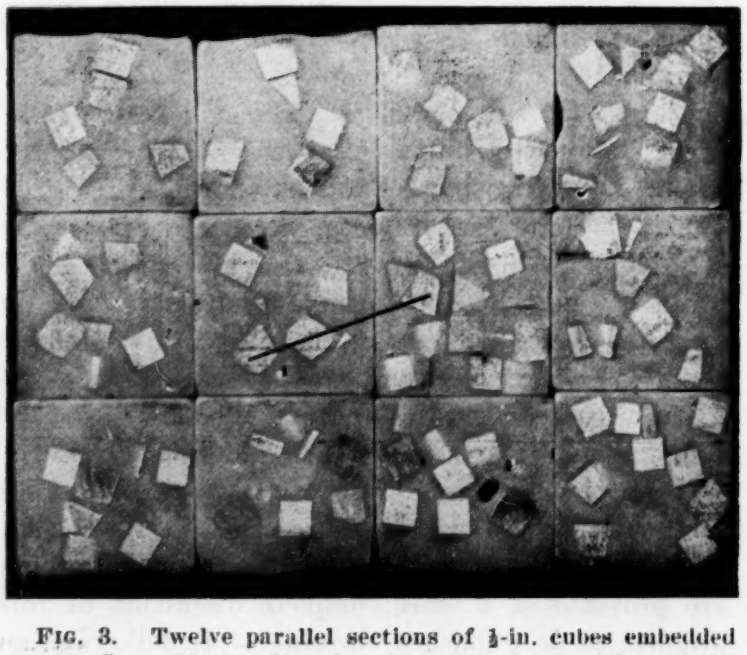

FIG. 3. Twelve parallel sections of $\frac{1}{2}$-in. cubes embedded in paraffin. The reading for the particular position of the needle is 2 hits and 4 cuts.

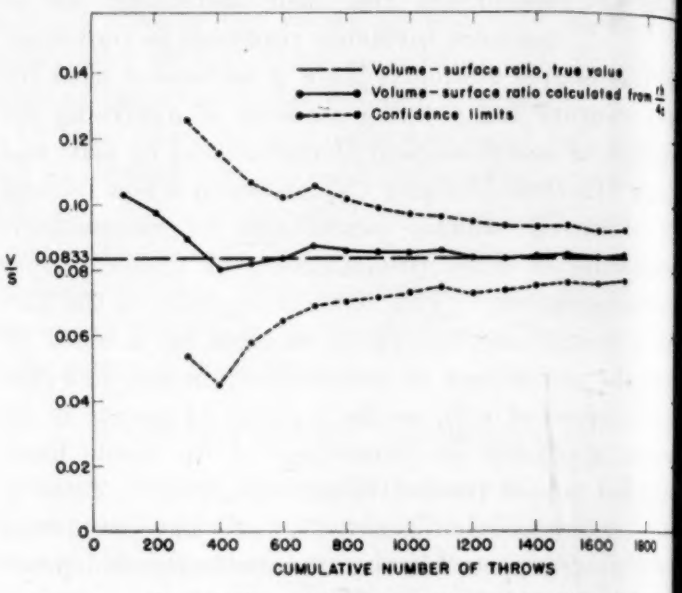

FIG. 4. Cumulative estimates from successive throws of volume-surface ratio for $\frac{1}{2}$-in. cubes.

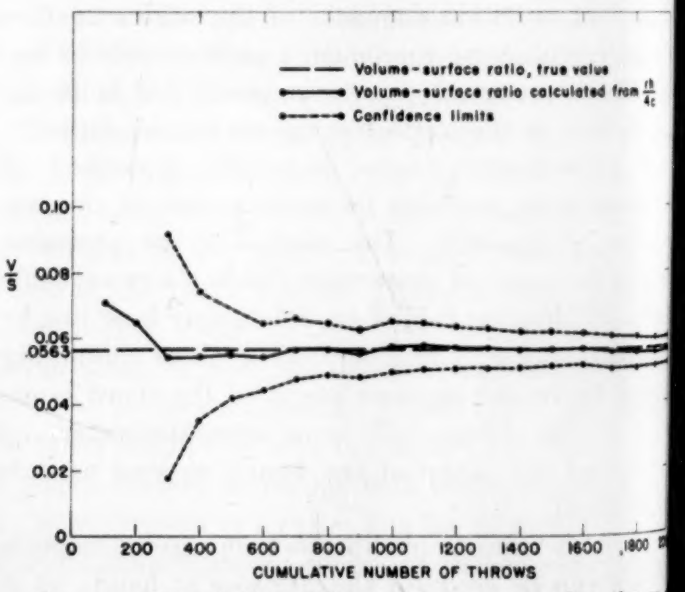

FIG. 5. Cumulative estimate from successive throws of volume-surface ratio for the reentrant figure.

cases the estimate of volume-surface ratio obtained differs from the known figure by less than 5%. The agreement appears satisfactory.

The 95% confidence limits shown in Figs. 3 and have been calculated from standard deviations computed from groups of 100 throws. They provide the basis for deciding when a sufficient number of throws has been made. Thus, after 2000 throws we can conclude, even in the absence of knowledge of the correct answer, that the correct value lies within 8% of the observed value with a probability of 0.95. After 1600 throws the correct value lies within 10% of the

served value, and after 900 throws within 15%. Thus, by calculating error limits it is possible to decide at any point when sufficient accuracy for the purpose at hand has been attained.

To determine the amount of subjectivity involved in reading hits and cuts, two different observers independently recorded hits and cuts for the same 2000 throws on the reentrant figure. In all doubtful cases they recorded separately their first and second choices. In no case do the differences exceed 6% (Table 1).

TABLE 1

ESTIMATES OF A TRUE RATIO OF 0.0563 INDEPENDENTLY OBTAINED BY TWO OBSERVERS FROM THE SAME 2000 THROWS

Observer	Estimated $\frac{V}{S}$ based on	
	Use of first choice	Use of second choice in doubtful cases
A	0.0584	0.0572
B	0.0557	0.0550

In applying the present method to microscopic sections, the major problem is in achieving randomness. When the morphologic components under study are not oriented, or when they are approximately spherical, the technique used by Chalkley for achieving randomness (*2*) should be satisfactory. For this purpose a reticle with a line of suitable length engraved or otherwise inscribed thereon is substituted for the five pointers used in the method referred to. The manipulation is identical but cuts as well as hits are observed and recorded. Of course, the length of the visual image of the line in the focal plane must be measured for the particular magnification used, and treated as the contant r in the calculations. When the components are oriented and are not approximately spherical, however, parallel sections cut through the tissue will not provide random sections. In such cases special precautions will be needed to insure randomness.

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TECHNICAL PAPERS

The Enzymatic Hydrolysis of Chloramphenicol (Chloromycetin)[1]

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With the development of the new antibiotic chloramphenicol, (chloromycetin) (*1, 3, 6*) and identification as D(-) threo-1-*p*-nitrophenyl-2-dichloracetamido-1, 3-propanediol (*2, 4, 5*), experiments were undertaken to determine if this compound could be inactivated by enzymatic hydrolysis of the amide linkage present in the compound. This linkage appears to contribute substantially to the bacteriostatic properties of chloramphenicol.

In the initial series of experiments with *E. coli*, *B. mycoides*, *P. vulgaris*, and *B. subtilis*, it was found that chloramphenicol could be hydrolyzed when introduced into actively growing broth cultures of these organisms. The decrease in bacteriostatic potency of the filtrates from these cultures was followed by means of a microbiological assay method for chloramphenicol using *Shigella sonnei* (*6*).

The organisms tested showed considerable variation in ability to hydrolyze the antibiotic. *P. vulgaris* and *B. subtilis* proved to be the best source of the enzyme. Cultures of these organisms possessed approximately twice the enzymatic activity of *B. mycoides* cultures and about three times the activity exhibited by *E. coli* cultures.

The results obtained, using actively growing cultures, did not indicate whether the enzyme destroying the antibiotic was an extracellular or endocellular enzyme. When filtrates from 24-hr broth cultures of the organisms were incubated for 24 hr at 37° C with chloramphenicol, no hydrolysis of the antibiotic was observed. However, filtrates from cultures 2–4 weeks of age actively destroyed chloramphenicol and a fairly active preparation of the enzyme could be obtained by concentration of the filtrate. The enzyme is therefore liberated into the culture medium. The enzyme could also be detected in suspensions of washed bacterial cells and in the autolyzates prepared from the washed cells.

[1] Trademark Parke, Davis & Company.

The enzyme involved in the hydrolysis of chloramphenicol has been tentatively designated as enzyme A to distinguish it from the other enzymes which might be involved in the enzymatic destruction of the antibiotic through attacks on other groups present in the molecule. The action of the enzyme is to hydrolyze the amide linkage of chloramphenicol and thus liberate the corresponding basic amine and dichloroacetic acid, which have been isolated and identified by chemical means from the enzymatic digests of chloramphenicol.

The optimum conditions for the enzymatic hydrolysis of chloramphenicol have been found to be pH 7.5 and a temperature of 37.5 to 40.0° C. The rate of enzymatic hydrolysis increased with substrate concentration up to 2 mg per ml. This is approximately the maximum solubility of chloramphenicol under the test conditions.

One unit of enzyme activity has been arbitrarily chosen as that amount of the enzyme which will hydrolyze 1 μg of chloramphenicol in 1 hr at pH 7.5 and 37.5° C.

Initial studies on the properties of this enzyme involved in the hydrolysis of chloramphenicol indicate that it is probably very similar to other proteolytic enzymes that have been isolated from bacterial cells. Moreover, this enzyme is neither a true papain nor a trypsin, since highly active preparations of these latter enzymes do not hydrolyze chloramphenicol to any great extent. The enzyme appears, however, to be activated by cysteine and other reducing agents, so that it is probably more closely related to the papain group than to the trypsin group of enzymes. Crystalline preparations of pepsin and chymotrypsin were found to be inactive on chloramphenicol.

Further studies on the distribution and properties of this enzyme are in progress and will be reported later.

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Absorption Spectrum of Beta Carotene in Liquid Solution at the Temperature of Liquid Nitrogen[1]

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In a recent paper in another journal (*1*), we describe solutions of salts fluid at the temperature of liquid nitrogen. One of the solvents employed consists of one part in ten of *n*-propyl alcohol and the remainder is equally divided between the liquids propane and propene.

[1] This document is based on work performed under Contract Number W-7405 eng 26 for the Atomic Energy Project at Oak Ridge National Laboratory.

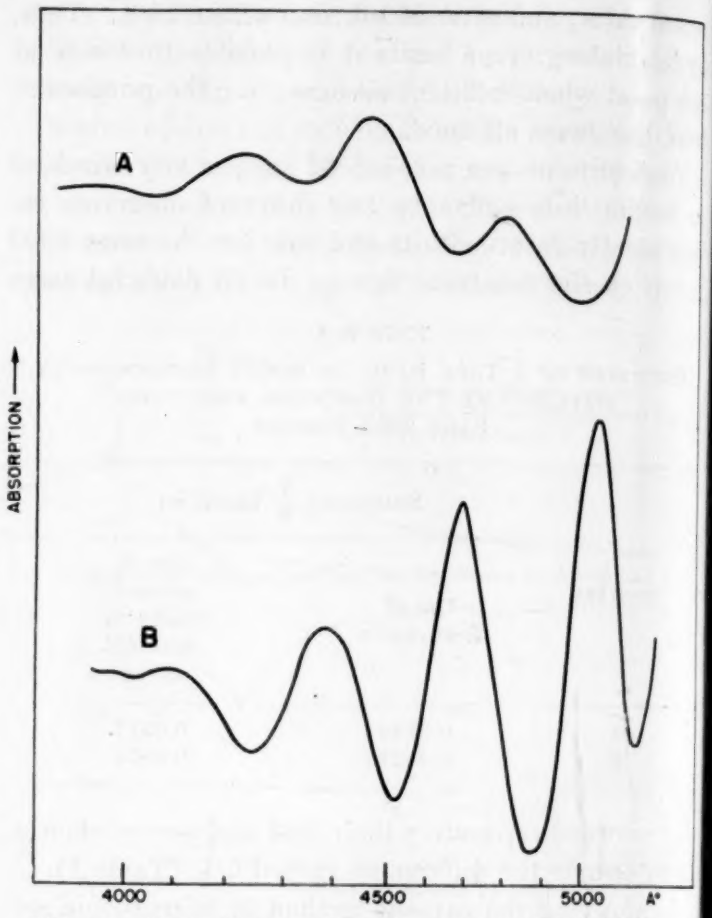

Fig. 1. Absorption spectra of carotene (90% alpha and 10% beta). A—In heptane at room temperature; B—In equal volume mixture of propane and propene at −196° C.

To obtain as refined a spectrum of a solute as possible, it is recognized that solvents such as alcohol and ether are to be avoided, since they possess permanent electric dipole moments, and they would be expected to distort the solute molecules. For this reason, hydrocarbons such as hexane frequently serve as solvents.

Our mixed solvent without alcohol, namely, a solvent consisting only of liquid propene and liquid propane in equal volumes, proved to dissolve carotene rather rapidly at about −50° C and maintain it in solution at −196° C in sufficient concentration to give an absorption spectrum in a path length of 25 cm.

The spectrum at −196° C, as may be seen from the traces, differs markedly from that of carotene at room temperature dissolved in heptane. The number of absorption peaks seems to be the same, but their relative intensities differ greatly. They are much sharpened and are in general displaced toward long wavelengths at the low temperature.

On lowering the temperature of the solution in propane-propene from −80° C to −196° C, changes consistent with these took place.

The solute consisted of 90% beta carotene and 10% alpha carotene.

We are much indebted to Dr. Martin Kuna, of our Biology Division, not only for some biologically important substances but also for a discussion of great value to us on their chemical and spectroscopic properties.

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An Interpretation of the Cause of Water-repellent Sandy Soils Found in Citrus Groves of Central Florida

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Several reports (*3–5*) have appeared in soil literature discussing the property which prevents the soil from being properly wetted by either rain or irrigation water. This property, water repellency, is widespread and quite pronounced in much of the citrus-growing area of Florida. Under many trees a large volume of soil remains dry even after prolonged periods of rainfall. A drop of distilled water, placed on the soil, behaves as if it were on a waxed surface. In some cases the drop of water will evaporate in place without any penetration; in other cases it will gradually penetrate the soil after several hours.

During the rainy seasons of 1947 and 1948, differences in the prevalence of water-repellent soil were noted in a group of plots having different fertilizer treatments, located at the Citrus Experiment Station at Lake Alfred, Florida. The treatments had been in effect 10 years. Determinations of the relative amounts of water-repellent soil were estimated by placing a drop of distilled water on soil samples taken from beneath trees and observing the time required for absorption. This was done by taking samples to a 6-in. depth with a stainless steel tube 1 in. in diam, turning the sample tube upside down and placing the drop of water on the exposed soil surface. If the drop of water did not soak into the soil within 10 sec, the soil was listed as water repellent; if it did soak in, it was listed easy to wet. Eighty examinations were made in each plot and the results from duplicate plots combined. The results of this investigation are shown in Table 1.

These results indicate that fertilizer practices influence the amount of water-repellent soil found under field conditions. It appears that the use of magnesium in the fertilizer, along with a separate application of ground limestone to control soil pH at about 5.8, is associated with the water-repellent phenomenon.

It is known that fatty acids form very insoluble soaps with calcium, magnesium, and other metals and that these soaps, when dry, are extremely water repellent. Waksman (*6*) had previously cited the presence of fatty acids, fats, and waxes in soils. With this in mind, several composite soil samples which exhibited the water-repellent property were checked for the presence of fatty acids. This was done by heating the soil in the presence of a strong sodium hydroxide solution, neutralizing with sulphuric acid, and steam-distilling in the presence of a slight excess of acid. A small amount of solid material was obtained which gave a test for a carboxylic acid group (*1*).

A dilute ether solution of the solid material obtained from this steam distillation, when added to subsoil, which wet very easily, had no effect on its wettability. However, when a dilute aqueous solution of calcium or magnesium hydroxide was added to the soil, which had been previously treated with the ether extract, the soil became very water repellent when it was dry.

This was further checked by treating an easily wetted soil with a dilute solution of stearic acid in ether. The ether was evaporated and then a dilute solution of either calcium or magnesium hydroxide was added and the soil dried. Following this treatment the soil became extremely water repellent. Evidently the formation under field conditions of metallic soaps results in water-repellent soil and a similar water repellency can be produced in the laboratory by similar chemical combinations.

TABLE 1

RELATIONSHIP OF FERTILIZER TREATMENT TO AMOUNT OF WATER-REPELLENT SOIL

Plot Nos.	Fertilizer treatment	July 1947 % water-repellent soil	August 1948 % water-repellent soil
1 and 12	3-6-8-4-1-½* 40% N organic source pH 5.8†	23	18
2 and 11	3-6-8-0-1-½ 100% N inorganic source pH 5.8†	4	1
3 and 10	3-6-8-2-1-½ 100% N inorganic source pH 5.8†	29	30
4 and 9	3-6-8-4-1-½ 100% N inorganic source pH 5.8†	23	23
5 and 8	3-6-8-4-1-½ 100% N inorganic source pH not controlled (4.2)	0	1
6 and 7	3-6-8-0-0-0 100% N inorganic source pH not controlled (4.2)	5	8

* The figures refer to percentages of various constituents in the fertilizer in the following order: N-P_2O_5-K_2O-MgO-MnO-CuO and as determined by A.O.A.C. methods for fertilizers. The fertilizers indicated were applied at 60 lb per tree per year.

† pH controlled with high Ca limestone.

Jacobson and Holmes (*2*) found that metallic soaps, such as magnesium stearate, are practically insoluble in ether, but that magnesium stearate is relatively soluble in methyl alcohol. Jamison's work (*4*) indicated that a water-repellent soil, extracted with ether, remains water repellent. With these facts in mind a sample of water-repellent soil was extracted first with ether to remove any free fats and waxes, then with methyl alcohol. This treatment left the soil readily wettable. The methyl alcohol extract, when evaporated on an easily wetted soil, left the soil water repellent, whereas the ether extract had no effect. When a portion of the methyl alcohol extract was evaporated to dryness, nitric and perchloric acids added for destruction of organic matter, and heat applied, small globules of fat were released. Further heat oxidized the fat, and the residue, when taken up in distilled water, gave strong magnesium and calcium tests.

This indicates that calcium and magnesium soaps had been dissolved by the methyl alcohol.

From this and other corollary information, it has been concluded that it is the formation of a water-repellent coating of metallic soaps on the soil particles (98% silica) that causes the water-repellent property found in many Florida soils. The source and identity of the particular fatty acids involved have not yet been determined.

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Near Infrared Absorption Spectra of Uracil, 5-Chlorouracil, and Thymine[1]

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Infrared spectrometry has proved very useful in studying biologically active materials (*5*), particularly if they are soluble in solvents which are transparent in the same region of the spectrum. In proteins (*1, 4*) and the components of nucleic acids (*2, 3*), the lack of solubility in other than aqueous solvents has made it necessary to use thin films, powders, suspensions, and the like. We have found that fused antimony trichloride is a powerful solvent for some of these materials and nearly 0.2 molar solutions of uracil, 5-chlorouracil, and thymine were readily prepared at 100° C. After a vacuum distillation, the fused antimony trichloride was suitably transparent and showed only two small absorption peaks at 1.93 and 1.42 μ (believed to be an O-H stretching overtone). These peaks cause no trouble, since their effect is subtracted out with the background. We have not investigated the absorption spectra of antimony chloride beyond 2.3 μ, but one might reasonably expect it to be transparent as far out as carbon tetrachloride or perhaps silver chloride. This aspect of the problem is being studied further.

The near infrared spectra of the compounds reported in this paper were measured with a Perkin-Elmer spectrometer model 12-B. A flint glass prism and tungsten light source were used, with a constant slit width of 0.475 mm. The absorption cell was constructed of Monel metal and had a diameter of 2.5 and a length of 4.0 cm. Glass windows were used with Teflon gaskets. The cell was heated electrically to 100° C.

The results obtained are shown in Fig. 1 and tabulated in Table 1. For comparison we have included the absorption spectra of phenol and acetamide. The concentrations are about 0.2 molar. In addition, chlorouracil

[1] Supported in part by the Atomic Energy Commission and the Office of Naval Research.

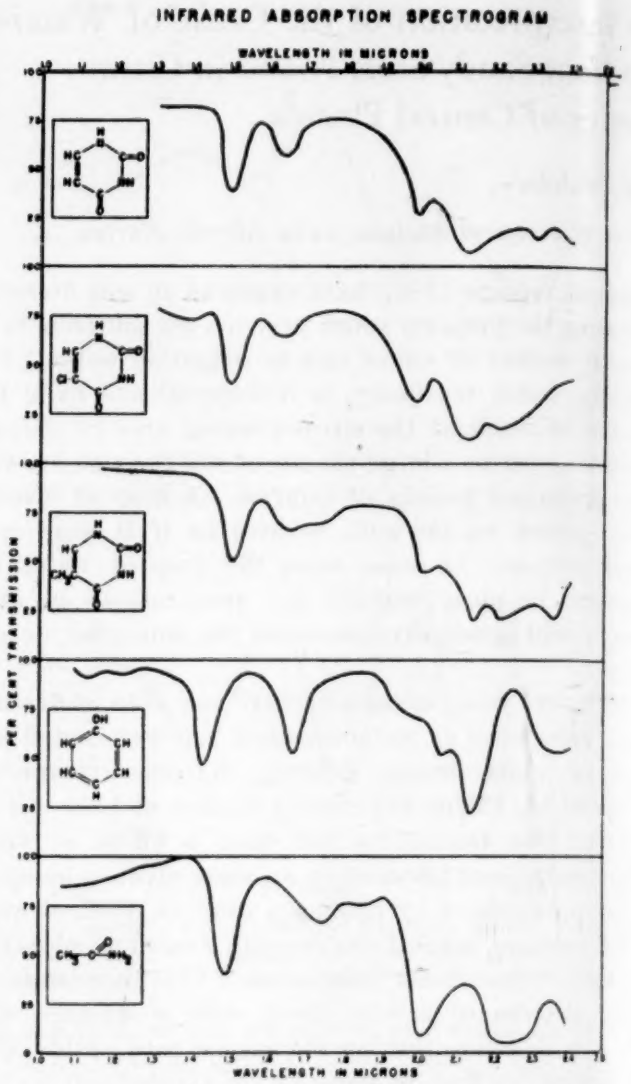

FIG. 1.

absorption curves were run at 0.18, 0.28, and 0.43 molar. The effect of increasing the concentration of chlorouracil is simply to deepen the various absorption bands. No broadening characteristic of hydrogen bonding was obtained, and we infer that in this solvent compounds are present in a monomeric form.

TABLE 1

NEAR INFRARED ABSORPTION BANDS (IN ANTIMONY TRICHLORIDE)

Uracil	5-Chloro-uracil	Thymine	Phenol	Acet-amide	Assignment
ab	ab	ab	1.43	ab	O-H
1.50	1.50	1.51	ab	1.49	N-H
1.65	1.65	1.68	1.67	ab	C-H (ring)
ab	ab	1.75	ab	1.75	C-H (aliphatic)
1.99	1.99	2.00	ab	2.00	C=O ?
2.13	2.13	2.14	2.14	ab	C-H (combination ring)

Uracil, chlorouracil, and thymine all show sharp, deep bands at 1.50 μ. Bath and Ellis (*1*) concluded from a study of various proteins that absorption at this wavelength corresponds to the first N-H overtone. The very deep band at 1.49 μ in the spectrum of acetamide confirms

this assignment. In phenol strong absorption occurs at 1.43 μ. This corresponds to the first O-H overtone. Since uracil and its derivatives do not absorb in this region but do absorb in the region characteristic of the first N-H overtone, it is inferred that these compounds exist predominantly in the keto form when dissolved in antimony trichloride.

The absorption at 1.65 μ shown by uracil, chlorouracil, and thymine is attributed to the first C-H overtone characteristic of ring compounds. The absorption is quite strong for phenol, which has five such hydrogen atoms, and quite weak for chlorouracil, which has only one C-H bond per molecule. The broadening of the C-H band toward the infrared in the case of thymine can be attributed to the aliphatic C-H overtone of the methyl group. The second dip in this broad band is centered at 1.75 μ, which coincides nicely with the methyl type C-H band of acetamide.

Uracil, chlorouracil, thymine, and acetamide show absorption at 1.99–2.00 μ; this band is absent in phenol. It is probably due to the second carbonyl overtone vibration which is known to lie in this region (*1*). All of the compounds except acetamide absorb at 2.13 μ. This band may be due to a combination of the fundamental valence and deformation vibrations of a ring C-H group. Beyond 2.1 μ the results are uncertain because the flint glass prism begins to absorb strongly and reduces the light intensity. Complete details of the spectra will be published elsewhere.

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Experimental Mixed Infection of Mice with Lansing Poliomyelitis Virus and Western Equine Encephalomyelitis Virus

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The phenomenon of interference between virus agents has been claiming increasing attention during the last decade. Interference has been demonstrated between plant viruses, between bacterial viruses (bacteriophages), and between animal viruses. In some cases when interference occurs the growth of one virus is inhibited, as evidenced by failure subsequently to demonstrate its presence (*1*, *6*), while in other cases the growth of both viruses is inhibited (*3*). On the other hand, it has been shown that two viruses may grow together without apparent interference (*4*, *5*).

In an attempt by the author to demonstrate interference between the viruses of equine encephalomyelitis and poliomyelitis in mice, it became apparent that such interference reported in monkeys (*2*) did not occur in mice. It was evident that both viruses grew in mice and that either or both could produce symptoms and death. If any antagonistic effect at all was manifested it consisted solely of a prolongation of life in some of the mice.

Lansing poliomyelitis and western equine encephalomyelitis viruses were chosen because their incubation periods and symptomatology made it easy to distinguish between them in mice. Because the Lansing virus has an incubation period averaging 7–9 days and the W.E.E. virus kills regularly in 48 hr, the W.E.E. virus was inoculated later so that both viruses could reach effective concentrations at about the same time. Accordingly, several preliminary experiments were run to work out the mutual relationships of dosage and time interval between administration of the viruses.

In one of these experiments using 30 mice it became apparent that LD_{50} doses of the two viruses would not give significant data without the use of extremely large groups of animals. It seemed desirable that all animals in the two control groups (Lansing virus alone and W.E.E. virus alone) should die in a reasonable period of time. Titration of the W.E.E. virus showed that 0.03 ml of a 1:1000 dilution inoculated intracerebrally would kill all mice injected in 2–3 days. The Lansing virus, however, presented a more complex problem. A single intracerebral inoculation of the supernatant fluid (allowing suspension to stand for 10–15 min for settling of coarser tissue fragments) of a 10% suspension of mouse brain and cord never killed all of the mice injected, and even among those that did die the incubation period of some was prolonged to 2 or 3 weeks. However, killing of all mice could be achieved by two inoculations of virus spaced 48 hr apart. Further, this served to shorten the incubation period somewhat. The preliminary experiments showed also that a time interval of 3 days between the second inoculation of Lansing virus and the administration of W.E.E. virus would probably be optimal.

A group of 62 10-g white mice were used for the experiment here reported. Fifty-two of these mice received two intracerebral inoculations of Lansing virus spaced 48 hr apart. One mouse was killed by the inoculation procedure. On the morning of the third day following the second injection, 14 of these mice were either dead, moribund, or showed typical poliomyelitis paralysis. These were arbitrarily set aside to constitute a poliomyelitis virus control group. The remaining 37 Lansing mice, together with the ten uninoculated mice, were injected with W.E.E. virus. The ten W.E.E. mice all died with typical symptoms in 48 hr. Of the 37 mice receiving both viruses, 17 died in 2–17 days with typical poliomyelitis symptoms, 11 died in 2–3 days with typical W.E.E. symptoms, and eight died in 1–9 days with what were judged to be mixed symptoms. One mouse did not die.

The brains and spinal cords of five of the mice receiving both viruses and dying with typical poliomyelitis

symptoms were removed. The cord and brain stem were removed from each brain and the cords and brains pooled separately. These were ground, diluted to 1: 100 and 1: 1000 and injected into white mice, all of which died in 48 hr with typical W.E.E. symptoms. Similar results were obtained with brain and cord material removed from mice dying with W.E.E. symptoms and from mice dying with symptoms judged to be a mixture of the two diseases.

It is apparent that mice dying with typical poliomyelitis symptoms had W.E.E. virus in high concentration in the central nervous system, and it seems reasonable to infer that there was a concomitant growth of these viruses. It seems reasonable further to assume that whether a mouse died with poliomyelitis or encephalitis was a fortuitous circumstance depending on which virus happened to gain the ascendancy. Unfortunately, the long incubation period of poliomyelitis virus and the short incubation period of W.E.E. virus precluded the possibility of demonstrating the presence of poliomyelitis virus in mice dying with W.E.E. symptoms.

The question why certain viruses interfere with each other while other viruses may grow together in the same host organ or tissue remains unanswered. The observations here reported, that equine encephalomyelitis virus and poliomyelitis virus may grow together in the brains of mice, whereas these viruses interfere with each other in monkeys, do not clarify the situation but nevertheless provide additional information. An elucidation of this fundamental problem will undoubtedly add greatly to our knowledge of the basic mechanisms of virus growth.

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Thyroid Destruction by I^{131}, and Replacement Therapy[1]

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The early work of Graham (*1*) on milk cows, and of Winchester (*5*) on chickens demonstrated a very definite relationship between thyroid function and milk and egg production. Winchester (*6*) also found a parallelism between thyrotropic hormone content of the pituitary, basal metabolism, and egg production of hens. Subsequently, numerous reports have been made concerning the use of various drugs that in one way or another influence metabolism, and eventually the production of farm animals (*3*, *4*). The literature is characterized by a certain amount of disagreement as to the effects of the drugs, and emphasizes the need for further research on the fundamental aspects of thyroid function.

This report presents a method by which thyroids of young chickens have been eliminated by I^{131} irradiation, apparently without damage to the animal other than some possible destruction of parathyroid tissue; a procedure similar to that of Gorbman (*2*), who has reported 100% destruction of thyroids of 2–5-month-old mice by I^{131} injected in doses ranging from 18 to 55 mc of activity per kg of body weight. The work reported here, however, deals with thyroid destruction by I^{131}, or radio-thyroid-ecrexis,[4] during the first few days of life rather than after the animal has reached full size. Further, by means of thyroxin therapy, birds lacking thyroid glands were brought to full size and into egg production, while similar birds that did not receive thyroxin survived for limited periods only, and grew very slowly.

TABLE 1

IODINE 131 DOSAGE AND PERCENTAGE THYROID DESTRUCTION (RESULTS OF FIVE TRIALS)

Dose I^{131}	No. of chicks	Exposure period	Estimated thyroid destruction
mc/100 g		days	%
1–1.9	2	5	0
	1	over 24	10
2–2.9	1	5	10
	1	5	50
	1	over 24	75
3–3.9	1	over 24	90
	4	over 24	100
4–4.9	1	5	nearly 100
	1	over 24	90
	4	over 24	100
5–5.9	1	5	nearly 100
	4	over 24	100
6–6.9	2	over 24	100
9.2	2	over 24	100

The birds used in these experiments were New Hampshire chicks, obtained from a commercial hatchery, and weighed 40–66 g at the time of I^{131} injection.

[1] Published with the permission of the Director of the Florida Agricultural Experiment Station.

[2] Present address: Animal Husbandry Division, U.S.D.A. Agric. Res. Center, Beltsville, Maryland.

[3] Present address: University of Tennessee, Knoxville, Tennessee.

[4] Since the literature apparently includes no term indicative of thyroid elimination by other than surgical means, the authors have deemed it necessary to introduce a suitable term in order to avoid undue repetition and use of descriptive material. After due consideration, the term "radio-thyroid-ecrexis" (pronounced *e-krek'-sis*) has been selected to indicate total destruction of the thyroid gland in the live animal by means of a radioactive substance such as I^{131}.

Grateful acknowledgement is due Dr. Joseph Brunet, professor of ancient languages, University of Florida, for his cooperation in offering a number of possible terms from which a final selection was made by the authors.

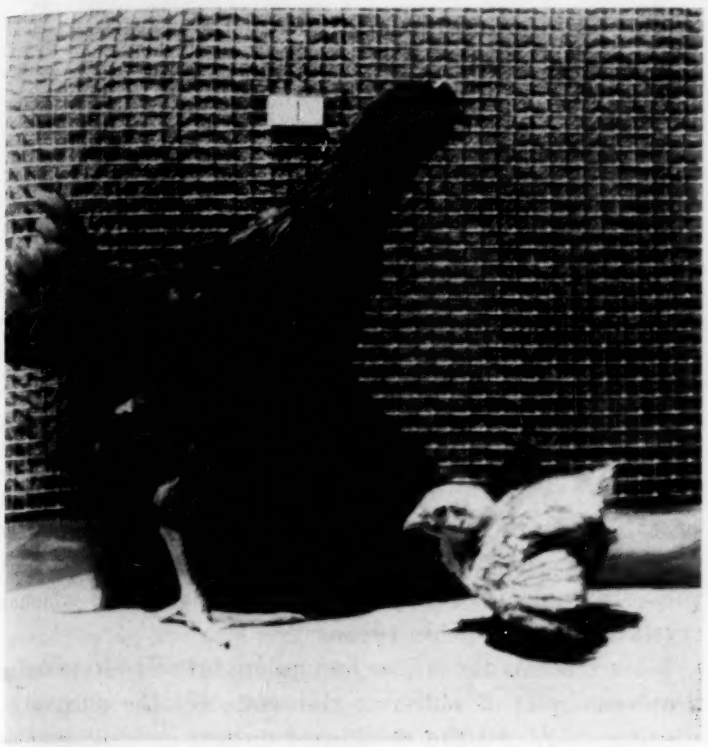

FIG. 1. Influence of radio-thyroid-ecrexis on growth. Control at left, I^{131}-injected bird at right. Both birds photographed at 7 weeks of age.

Carrier-free I^{131} in solution of pH 7–9, which had been prepared by pile-bombardment of tellurium, was used in this work. The values given for the activities of I^{131} were based upon the Oak Ridge National Laboratory measurements and refer to the activity actually injected.[5] Suitable precautions were used to make sure that persons were not exposed to above-tolerance radiation during administration of the isotope and handling of the birds. The I^{131} injections were given intraperitoneally and the puncture was sealed in most cases with collodion.

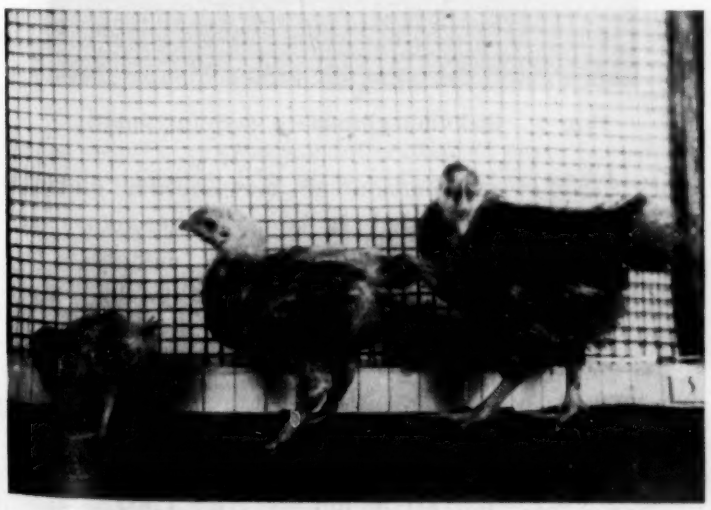

FIG. 2. Effect of thyroid replacement therapy on a bird lacking thyroid. Normal control at right, thyroid-ecrecticized bird injected daily with thyroxin at center. The three birds were 5 weeks of age when photographed.

[5] The radioactive iodine was supplied by the Oak Ridge National Laboratory on allocation from the U. S. Atomic Energy Commission. The ratio of the Oak Ridge National Laboratory millicurie unit of I^{131}, used in the work reported here, to the new National Bureau of Standards millicurie unit is 1.75 : 1.00.

The wing was used as the site of intradermal injection of synthetic D,L-thyroxin in water suspension. A commercial starting and growing mash was fed all birds, and to compensate for possible parathyroid injury, 0.5% calcium gluconate was added to the ration.

On autopsy, sections of thyroid tissue were prepared by the freezing technique in the first two trials, and serial sections were prepared in later experiments.[6] When no trace of the thyroid capsule was found in I^{131}-treated birds, a mass of tissue that included the normal thyroid site was prepared for sectioning.

The degree of thyroid destruction accomplished by various doses of I^{131} and lengths of exposure to radiation are given for five of six trials in Table 1. These results indicate that doses of about 6 mc or more of activity per 100 g of body weight over periods of 24 days (three

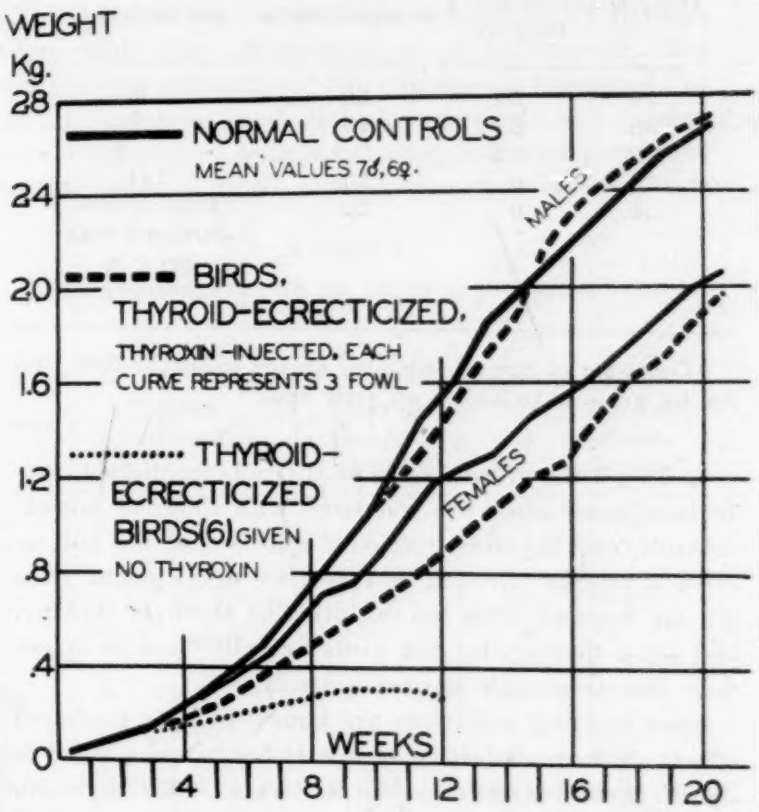

FIG. 3. Influence of radio-thyroid-ecrexis on growth, and of thyroxin on growth of birds lacking thyroids.

times the half-life of I^{131}) accomplished complete destruction of the thyroids in the five trials. An anomalous situation existed in the case of trial No. 4, in which even 6.5 mc of activity failed to accomplish complete thyroid destruction. The results of this trial are not included in this report. No explanation has been found for the negative results obtained in this one trial.

Injected chicks, in which thyroids were not found on autopsy, grew very slowly and survived only a limited time after injection (7–18 weeks) unless they were given thyroid replacement therapy. In Fig. 1 are shown a control bird and a thyroid-ecrecticized chick, both 7 weeks

[6] Grateful acknowledgement is due Drs. Nelson A. Murray and Lucien Y. Dyrenforth, of Jacksonville, Florida, in whose laboratories most of the sections were prepared.

of age. In trials 5 and 6 the smaller of each pair of chicks injected with I^{131} at a given level was selected about 2 weeks after injection for replacement therapy. Thyroxin in water suspension was injected daily at a level of 3.8 μg in trial 5, and 5.7 μg in trial 6, per 100 g body weight.

The first visible response to thyroxin injection was rapid resumption of growth. In Fig. 2 are shown a normal control bird, an I^{131}-injected bird, and a thyroid-ecrecticized chick given daily injections of 3.8 μg thyroxin daily.

TABLE 2

EGG PRODUCTION OF THYROXIN-INJECTED HENS AND OF CONTROLS

Hen No.	Dose I^{131} in mc per 100 g body wt	Laid first egg at age in weeks	Egg material per week in g
34	3.1	20	156
56	6.9	19	169
59	9.2	..*	...*
35	0	20	144
54	0	22	Entered production 4 days prior to autopsy

* Condition of the reproductive organs indicated that Hen No. 59 would have laid at an early age.

In Fig. 3 the growth rates of thyroid-ecrecticized, thyroxin-injected birds are compared with those of normal controls, and thyroid-ecrecticized chicks that did not receive thyroxin. Growth and feather development were quickly resumed after the initiation of thyroxin therapy, and some thyroxin-treated birds actually became larger than the comparable normal controls.

Since ionizing radiations are known to have profound effects on the reproductive organs, the egg-producing ability of thyroid-ecrecticized birds, treated with thyroxin, is of particular interest. The experiment was terminated before more than two of the control females had entered production. Two of the three thyroid-ecrecticized females ovulated, and as is shown by Table 2, their rates of production were excellent when the age of the birds is taken into consideration. A third experimental female that received the relatively large dose of 9.2 mc of activity per 100 g body weight was found on autopsy to have developed normally, and presumably she would have laid at an early age.

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Microcrystallographic Data on Sodium-D-Glutamate (Monosodium Glutamate)

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During the period 1936–1940 the writer had occasion to examine microscopically samples of a substance which at that time was considered somewhat of a novelty as a table condiment. This material was the Japanese "Aji-No-Moto," long known and crudely prepared in the Orient as a food supplement. The samples submitted, however, were not pure, containing an appreciable amount of salt and other impurities. The method used for the examination of the material was that which had been previously applied to a microscopic study of the common crystalline amino acids (*4*).

More recently the writer had an opportunity to examine a pure sample[1] of sodium-D-glutamate for the purpose of placing on record the significant optical crystallographic properties of the substance. The increasing widespread interest in monosodium glutamate as a seasoner of foods (*1*, *2*, *5*, *6*) appears to justify a more complete microscopic description than has hitherto appeared. Partial crystallographic and optical data have been recorded (*3*, *7*), including only one refractive index.

FIG. 1. Sodium-D-glutamate (typical habit).

Microscopic examination of monosodium glutamate ($C_5H_8O_4NNa$) shows that it is crystalline, apparently crystallizing in the monoclinic system, elongated, prismatic forms characterizing the habit (Fig. 1). In parallel polarized light (crossed Nicols), the crystals are elongated parallel to axis *b*, showing parallel extinction and negative elongation. In convergent polarized light (crossed Nicols), partial biaxial interference figures occur, the optic axis figure being most usually shown. Optic sign (−). Refractive indices: $\alpha = 1.500$, $\beta = 1.550$, $\gamma = 1.592$, all ± 0.002.

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Aureomycin and Blood Coagulation

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Moldavsky, Hasselbrook, and Cateno (*5*) were the first to report that the blood of patients receiving injections of penicillin clotted much more quickly than normally. These observations were corroborated and extended experimentally in animals and human beings by Macht (*1*) both after parenteral injections and when administered by stomach. Macht further determined the relative thromboplastic efficiency of the four principal penicillins G, X, F, and K; and also found that streptomycin shortened the coagulation time of whole blood. The clinical bearings of these findings in regard to possible thromboembolic accidents have been also discussed by him (*2*). Recently, the antibiotic aureomycin, discovered by B. M. Duggar, has been introduced into medical practice. It was therefore deemed worth while to study its influence, if any, on blood coagulation.

TABLE 1

EFFECT OF AUREOMYCIN ON BLOOD COAGULATION TIME IN RABBITS

Rabbit	Wt in kg	Normal coag. time in min	Aureomycin in mg	Coag. time in min*	Coag. time in min†
A	3	11	15	9	7
B	2.8	11	10	9	7
C	3.4	10	100	5	1.5
D	2.5	11	65	3	3

* Tested about 1 hr after administration of drug.
† Tested in about 1½–3 hr after administration of drug.

Experiments with aureomycin were made on rabbits and cats, and clinical tests were made on patients who had not received any previous medication. In all of the experiments, the drug was administered by stomach. The clotting time of whole blood was measured by the Lee and White method before administration of aureomycin, and at various intervals afterward.

Table 1 shows the results of 4 rabbit experiments, in which various doses of aureomycin were given to the animals. It will be seen that in each case coagulation time was markedly shortened. Blood in all these was secured by cardiac puncture.

Table 2 gives results of an experiment on a cat and illustrates strikingly that no change occurred in coagulation time of blood taken repeatedly from the carotid artery before giving aureomycin. It shows also the progressive diminution in clotting time after administration of this drug.

TABLE 2

EFFECT OF AUREOMYCIN ON BLOOD COAGULATION TIME OF A CAT*

When tested		Coagulation time in min
10.10 A.M.		10.5
10.20 "		11.5
10.30 "		11.5
10.35 "	200 mg Aureomycin	
11.20 "		8
11.30 "		6
11.40 "		4
11.50 "		4

* Wt—4 kg.

Table 3 presents the findings obtained in 14 patients before and after administration of aureomycin. The patients were given one or two capsules of aureomycin of 250 mg each, the usual clinical dosage. It will be seen that in every case some shortening in coagulation time was produced. Control experiments on human subjects who did not receive aureomycin did not reveal such changes after repeated blood examinations.

TABLE 3

EFFECT OF AUREOMYCIN ON BLOOD COAGULATION TIME OF HUMANS

Patient	Dose in capsules*		Coagulation time in min before dose	Interval hr and min	Coagulation time in min after dose
Mr. D.W.	1	8	1	30	5
Mrs. S.	1	10.5	1		7.5
Mrs. G.	1	9	2		7
Mrs. K.	2	10.5	1	20	3.5
	(1 hr apart)				
Mr. Z.	"	10	1	20	7
Mrs. P.	2	14.5	1	45	8.5
	(together)				
Mrs. I.R.	"	12	1	30	9
Mr. C.	1	8.5	1		7
Mrs. B.	1	11	2	30	7.5
Mrs. M.	1	11	2	30	7
Mrs. D.	1	12	2	30	8
Mrs. B.R.	2	9	3	30	6
	(1 hr apart)				
Mrs. Z.K.	"	9	3	30	6
Mr. J.	"	9	3	30	6.5

* Each capsule contains 250 mg aureomycin.

Tests made on both human subjects and lower animals revealed no difference in prothrombin time, thus indicating that the diminution in clotting time is due to other factors involved in blood coagulation. Repeated tests of blood sera before and after administration of aureomycin revealed phytotoxic properties when tested by the author's phytopharmacological technique (*4*), as found in penicillin and streptomycin (*1*). Experiments now in progress with chloromycetin indicate similar properties.

The findings with aureomycin are of considerable practical clinical interest. There is undoubtedly a definite shortening of clotting time noted at the height of antibiotic therapy. While ordinarily nature provides a wide compensatory mechanism for prevention of thrombo-embolic accidents, still the coagulatory apparatus may be considered as in a metastable state, so that sudden physiological disturbances might precipitate thrombo-embolic accidents. Hence suitable prophylactic measures by use of anticoagulant drugs may be instituted.

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Body Retention of Carbon 14 from Labeled Sodium Bicarbonate[1]

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In view of the present wide usage of carbon 14 and the concern regarding possible radiation hazard involved, it is believed that certain data obtained on this subject are worth recording at this time. Bloom, Curtis, and McLean (*2*) and Armstrong, Schubert, and Lindenbaum (*1*) have previously published results indicating long term body retention of C^{14} from water soluble and insoluble carbonates. Brues and Buchanan (*4*) have reported some interesting results on the over-all metabolism of carbon dioxide.

The present experiments were designed to obtain quantitative data on $C^{14}O_2$ fixation, from which average body radiation could be calculated. Twelve mice were injected intraperitoneally with a solution containing 2.5 mg of $NaHC^{14}O_3$ and a total activity of 18 μc. The expired CO_2 from all animals was collected over varying intervals, and two mice were sacrificed for organ and tissue analysis at 24 hr, 48 hr, 1 week, 2 weeks, 4 weeks, and 3 months. The C^{14} assays were carried out on pooled blood, spleen, liver, kidney, lung, brain, small intestine, muscle, skin and hair, and bone samples. The procedures used in collecting expired CO_2 and excreta, oxidizing samples, and counting have recently been reported (*6*). The percentage of the total activity retained at a given time was calculated by difference (100% − expired and excreted C^{14}) for the first 24 hr; the activity retained after longer periods was calculated directly from organ,

[1] This work was carried out for the Atomic Energy Commission under a contract with the Office of Naval Research. Certain data reported herein were obtained in experiments carried out under a grant from the American Cancer Society on recommendation of the Committee on Growth, National Research Council.

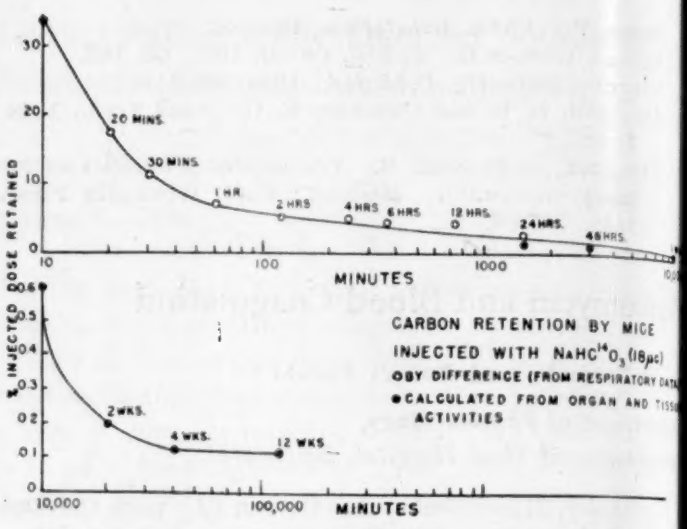

FIG. 1. Carbon 14 retention by mice injected with $NaHC^{14}O_3$.

tissue, and fluid weights, and specific activities. These results are presented in Fig. 1. If the amount of C^{14} in the body and the average energy of radiation are known it is simple to convert such data to roentgen equivalent physical[2] (the basis for radiation tolerance calculations). With the assumption of even distribution, such calculations have been performed with regard to total body radiation and are presented in Table 1. To date we have

TABLE 1

BODY RADIATION OF MICE INJECTED WITH $NaHC^{14}O_3$ (18 μc)

Period	Body C^{14} content (integrated)		Body radiation	
	μc	% of injected dose	Total rep period	Average daily rep period
0–60 min	4.3	23.6	0.0250	
1–2 hr	1.12	6.2	0.0058	
2–4	1.00	5.6	0.0104	
4–6	0.92	5.12	0.0090	
6–12	0.86	4.77	0.0266	
12–24	0.54	2.93*	0.0333	
0–24	0.87	4.80	0.110	0.1101
24–48	0.21	1.15	0.053	0.027
1–7 days	0.18	1.00	0.1328	0.022
7–14	0.07	0.41	0.0636	0.009
2–4 weeks	0.03	0.16	0.0496	0.004
4–12	0.02	0.13	0.1613	0.003

* This value is an average of the 12-hr C^{14} level obtained by difference (100% − % expired) and the 1.37% found in the tissues at 24 hr.

Note: Tolerance does limit for a 24-hr exposure as set by Clinton Laboratories = 0.1 rep.

observed no outstanding selective accumulation of C^{14} from a gross anatomical standpoint.[3] It was observed that the rate of uptake and loss of C^{14} by the jejunum (a rapidly proliferating tissue) was significantly greater

[2] One rep or roentgen equivalent physical = 83 ergs/g tissue. This dose is considered to produce no known effect on man when exposed indefinitely. Factor of safety is probably no more than 2 or 3 (*5*).

[3] The detailed results of these experiments, along with certain calculations as to rate constants having to do with carbon turnover, are being presented elsewhere.

than for other tissues studied. It is obviously necessary to carry this search for specificity into the finer structures of cells, organs, and bone.

When the difference in weight of a man and a mouse is taken into consideration, it is apparent from Table 1 that the average over-all body radiation from bicarbonate C^{14} is apt to be lower than the tolerance level of 0.1 rep per day for man unless high doses are administered (of the order of 5 mc if a safety factor of 10 is assumed for species variation in the biological half-life of bicarbonate (C^{14}). It is of course important to study the long term retention of C^{14} from insoluble carbonates and organic molecules which enter the metabolic pathways before being degraded to carbon dioxide, prior to any final conclusions regarding hazard from C^{14}.

Experiments designed to indicate the effects of low doses of $NaHC^{14}O_3$ on the pattern of leukemia in a highly susceptible strain of mice are now under way in this laboratory.

This report should not be construed to suggest at our present state of knowledge an increase in Brues' (*3*) tentative maximum retained dose for man of 30 μc of C^{14}.

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Action of the Venom of Bothrops Atrox on Fibrinogen

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It has been shown by Laki and Mommaerts (*3*) that the conversion of fibrinogen to fibrin takes place in two stages: first, thrombin brings about some change in the fibrinogen molecules, which then polymerize to a clot. These authors have also shown that a solution containing phosphate buffer, pH 5.1, fibrinogen and thrombin, does not coagulate. Clotting occurs only after neutralization of the system with secondary phosphate buffer. The longer the thrombin and fibrinogen are incubated at the acid pH, the shorter the clotting time becomes. This shows that a primary reaction takes place even at pH 5.1, and the polymerization of the primary product, the profibrin, into fibrin takes place only at a higher pH.

The thrombin-like clotting action on blood and fibrinogen of the venom of Bothrops atrox (*1*) has been compared with thrombin under the same experimental conditions as described by Laki and Mommaerts. In these experiments the fibrinogen solution was prepared according to the method of Laki (*2*). As clotting agents, thrombin of Parke and Davis Company, a saline Bothrops atrox solution in a dilution of 1: 15,000, and a venom solution precipitated three times with acetone and heated at 50° C for 20 min, were used.

To aliquots of fibrinogen solution brought to pH 5 with phosphate buffer there was added thrombin, or the venom, or the acetone-precipitated venom solution. After various incubation times a part of the reaction mixtures was removed and neutralized with secondary phosphate to pH 7, and the clotting time was measured.

Fig. 1 illustrates the coagulation curves obtained by the three different solutions. It can be seen that venom transforms fibrinogen into profibrin faster than thrombin,

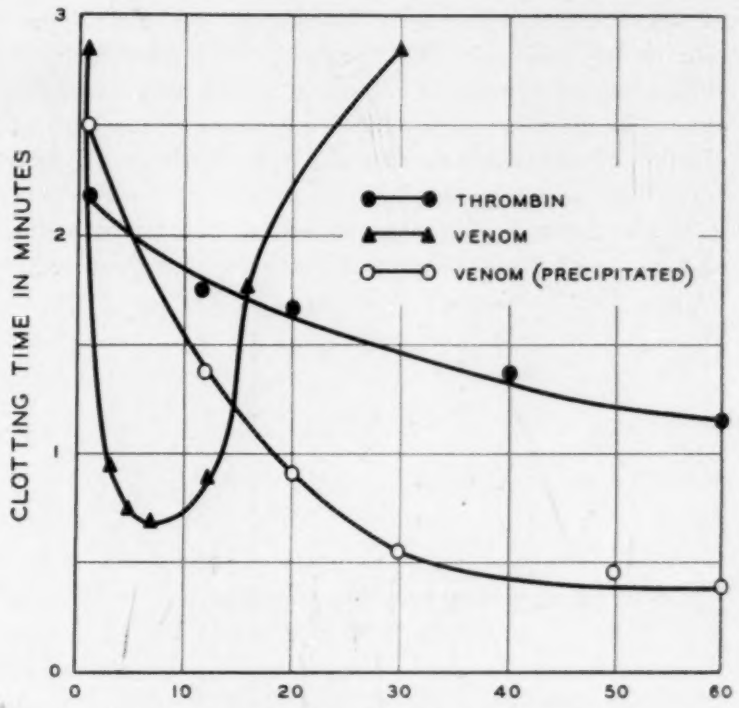

Fig. 1. The effect of incubation time on the clotting of reneutralized fibrinogen solution brought about by the action of thrombin, venom, and precipitated venom.

but after a certain time the clotting time becomes longer and longer, and finally the neutralized fibrinogen-venom-buffer system does not clot at all. Addition of thrombin to such neutralized solutions does not bring about coagulation, but if fibrinogen is added, clotting takes place. This shows that the reversal of the venom curve is caused by the disappearance of reactive fibrinogen, presumably due to fibrinolysin present in the venom. In the case of acetone-precipitated venom, the reaction is similarly fast, but the clotting time, having reached its lowest value, remains at this level.

These experiments with acetone-precipitated and heated venom solutions show that precipitation and heating eliminates, or at least reduces, the fibrinolytic action of venom, and that the clotting action of venom is not only due to its proteolytic activity but to some thrombin-like enzyme. Further details of this work will appear elsewhere.

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Comments and Communications

Welding Thermocouples

In a recent technical paper (*Science*, March 18, 1949, p. 281) James A. Riley presented "A Simple Method for Welding Thermocouples."

I should like to bring to your attention a description of a similar apparatus invented in Russia by a member of the "Vnidi," Engineer Velixon, for making pyrometers to be used on engine pistons. The usual couples, consisting of copper, constantan, nickel, and nichrome, cannot be used for such purposes because of the high incidence of breakage due to the low elasticity of these materials.

The best couple for measurement of the temperatures of high speed Diesel engines (1500 rpm) has been found

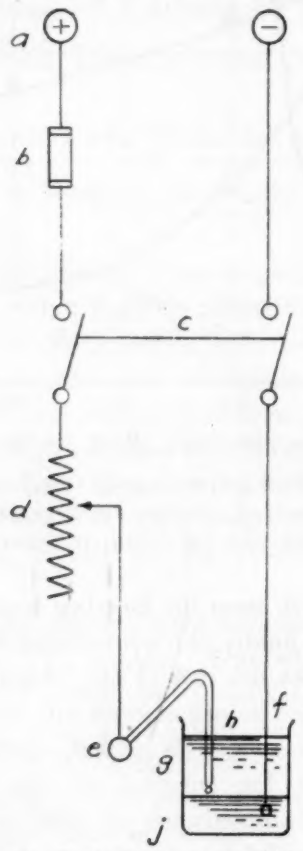

FIG. 1. Velixon apparatus for welding fine wires.

to be annealed steel and constantan. However, welding of the materials is difficult in an ordinary voltaic arc as the steel oxidizes.

Essential features of the Russian apparatus are shown in Fig. 1, and a description of the process (*Dieselestroyenive*, Nos. 4–5, 1932, p. 38) is as follows:

"One of the poles of the source of current (D.C. is preferable) is connected through fuse *b*, knife-switch *c*, and resistance *d*, to the terminal *e*. The other pole is connected to a wire dipped into vessel *f* containing mercury *j* and oil *g*. To weld the couple, the ends of the wires are twisted into a knot *h*, the free end of one of the wires being connected to terminal *e*. The knot is then dipped into the mercury and rapidly withdrawn. For an instant an arc is formed between the mercury and the wire knot while the latter passes through the oil, and this arc welds the tips of the wires together. An excellent joint is produced as the process takes place in a complete absence of air. Wire of diameter from 0.05 to 2.0 mm. can be welded by this method."

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International Polar Year of 1932–1933

The Second International or Jubilee Polar Year of 1932–1933 was sponsored by the International Meteorological Organization. That organization had also sponsored the First International Polar Year of 1882–1883, as the result of a suggestion made in 1875 by Lieutenant Karl Weyprecht of Austria. Weyprecht's premise that the scientific worth of polar expeditions would be immeasurably increased were they arranged to follow a uniform program to supply simultaneous physical data at many stations in high latitudes, was more than justified by the 20 or more published volumes on the results during 1882–1883.

Advances in all geophysical sciences since 1883, and especially since 1900, indicated that international pooling of resources in instruments, techniques, and methods would be most desirable for any program of polar expeditions, as for example, a second Polar Year of 1932–1933. The preparation of plans for the effort of 1932–1933 was placed by the International Meteorological Organization in the hands of a special International Polar Year Commission, under the presidency of the late Dr. D. la Cour, director of the Danish Meteorological Institute. Dr. La Cour instituted world-wide cooperation in the subject with the result that some 44 countries undertook to participate in the program. Twenty-two of these countries sent out special expeditions, several of which established new stations outside their own borders. In spite of the world-wide economic depression in the early 1930's the necessary funds were found through governmental appropriations and liberal grants from scientific endowments. The polar network of stations was augmented by special programs at existing geophysical observatories in lower latitudes and thus the Second Polar Year was in the truest sense world-wide.

The realization and accomplishment of the program as an international project is a monument to the enthusiasm and indefatigability of La Cour and to the support generously provided by the Danish Meteorological Institute. In spite of interruptions in investigations arising from World War II and the world's unrest in several years preceding that war, many valuable contributions to polar geophysical knowledge have already been made. But there remains much material not yet fully compiled or discussed and many completed or partially

completed manuscripts awaiting publication. It would be peculiarly unfortunate if the potentialities for increased understanding of polar geophysics resulting from this great project, in which so many nations and men took selfless part at great cost, were not fully harvested.

The International Meteorological Organization therefore appointed in November, 1946 a special committee to consider and report upon steps to be taken to complete reductions, analyses, discussions, and publications of the results of the Second International Polar Year 1932–1933 within a definite time limit. Following the committee's report of recommendations in Washington, D. C., to the Directors' Conference of the International Meteorological Organization on October 8, 1947, the Temporary Commission on the Liquidation of the Polar Year 1932–1933 of six members (J. A. Fleming [U. S.], J. Keränen [Finland], H. Petersen [Denmark], J. M. Stagg [Great Britain], H. U. Sverdrup [Norway], and A. Thomson [Canada]), was established. The responsibilities of this commission were defined as follows:

(1) *Terminal date.*—Terminal date for completion of all compilations, analyses, discussions, and final publications was set as December 31, 1950.

(2) *Duties of temporary commission.*—The temporary commission was authorized to (*a*) acquire services of scientific men as deemed desirable to effect completion of agenda on or before the terminal date, (*b*) approve expenditures of available funds or of funds made available from any source for necessary services and costs of publications, (*c*) set up a suitable central bureau and repository of all records, materials, and publications of the Polar Year 1932–1933, and of funds, and (*d*) appoint, with the approval of the director of the organization designated to house the central bureau, a part-time or full-time paid executive officer whose duties and responsibilities are to be set by the commission.

(3) *Funds and property.*—The commission is to (*a*) arrange for funds, other than those already available, and to disburse same and (*b*) have prepared a complete inventory of all instruments and property of the Polar Year Commission 1932–1933 showing (1) original purchases and (2) present distribution by gift or loan or in storage, as also to have authority to dispose of all in accordance with urgent needs of geophysical organizations for worthy projects contemplated.

(4) *Bibliography.*—The commission is to have prepared a complete bibliography of microfilms and publications and their availability for distribution.

(5) *Historical summary.*—Investigators seeking material and results concerning the First International Polar Year 1882–1883 have been disappointed not to find anywhere a single-volume published summary of the activities and publications of that enterprise, despite the numerous valuable contributions which came directly from the results. It is of first importance therefore that the commission arrange for preparation, publication, and wide distribution of a comprehensive, authoritative historical summary of the Polar Year 1932–1933, and of suitable condensations thereof for publication in leading scientific journals. This summary should include lists of (*a*) official resolutions relating to the enterprise by reference to published sources and by publication of those so far not published, (*b*) complete lists of organizations taking part and their contributions, and (*c*) complete lists of stations, personnel, equipment, and programs followed.

(6) *Classification for liquidation of agenda.*—The liquidation of the agenda is to be accomplished under four general allocations, namely: (*a*) meteorology and allied results; (*b*) geomagnetism, earth currents, atmospheric electricity and allied results; (*c*) auroral results; and (*d*) aerological results.

Early in 1948, with the approval of the Danish Ministry, the central bureau was set up at the Danish Meteorological Institute, and Dr. V. Laursen of that institute was made executive officer under the immediate direction of Director H. Petersen. Permission was also given for the part-time services of Messrs. J. Olsen and J. Egedal of the institute's staff to be available.

Balance of funds available (some $7,000) was generously supplemented by a final grant of $12,000 from the Rockefeller Foundation through its Board of Trustees, December 2–3, 1947. Of these funds a considerable amount has already been budgeted for various items in the liquidation. As any unexpended balances on December 31, 1950, must be reverted, it is urgently requested that all persons having Polar Year reductions, analyses, and manuscripts in mind will promptly communicate with the executive officer of the Central Bureau at Copenhagen with estimates of funds needed. There are now only some 15 months before the terminal date set by the directives given the commission.

The accomplishment of the program of the Second International Polar Year 1932–1933 was heroic. It would be a calamity and an injustice to those who gave so generously in funds, effort, and time not to see its work completed in respect to thorough compilation, analysis, discussion, and publication as a whole enterprise. The commission will be glad to hear from anyone who may already have published results (with full bibliographical particulars) or who may have some further research in mind, either partially completed or planned, based on data obtained during the Second International Polar Year. Any work to be undertaken must be completed and published by the terminal date set—December 31, 1950.

The completion of what was in the largest sense a distinctly cooperative and international effort, must insure general coordination of findings and their consideration in the broadest aspects. It will provide almost unlimited sources of observed and reduced data for the benefit of scientific investigations for many years to come in which uniform and world-wide simultaneous material is needed.

TEMPORARY COMMISSION ON LIQUIDATION
OF POLAR YEAR 1932–33
J. A. Fleming, President
Carnegie Institution of Washington
V. Laursen, Executive Officer,
Danish Meteorological Institute, Copenhagen

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Correction

Professor A. N. Winchell, of the University of Virginia, has called our attention to some inconsistencies in our paper "Crystalline Salts of Dihydrostreptomycin" (*Science*, 1949, **109**, 515). In the section describing the microscopic examination of crystalline dihydrostreptomycin sulfate, the following correction should be made: Lines 30 and 31 should read: "2V (calculated) 89°; *extinction*, parallel and/or oblique; *extinction angle* 18°" instead of "2V (calculated) −89°; *extinction*, parallel; *extinction angle* −18°."

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The Zoological Station of Naples

The Zoological Station survived the war without heavy damages. The laboratories and library lost some apparatus and books, but the building was not seriously damaged. The devotion of the personnel and the intelligent cooperation of allied military authorities are the main factors responsible for this fortunate circumstance. A short chronicle of what happened to the Naples Zoological Station during the war and the years of military occupation has been published by the writer in the first issue of the *Publicazioni della Stazione Zoologica di Napoli* (1946, **20**, pp. 75–86).

Since that time, fortune and numerous friends throughout the world have assisted the director, Prof. R. Dohrn, and his staff in their task of completely rehabilitating the old institute. Three reports have been published on the activity of the station (*Pubbl. Staz. Zool.*, 1946, **20**, pp. 87–89, covering the years 1943–45; 1947, **21**, No. 2, pp. I–VII; and 1949, **21**, No. 3, pp. I–VI). During the years 1943–46 only 11 scientists worked at the station besides the staff. In 1947 there were 57; in 1948, 33 Italians and 28 foreigners, a total of 61. Foreigners (1947–48) are distributed as follows: England, 14; Switzerland, 12; Sweden, 6; Holland, 4; U.S.A., 4; Belgium, France, Spain, 2 each; Chile, China, Denmark, Germany, Greece, India, Hungary, Turkey, 1 each.

The work done by the various scientists covers a wide field, including ecology and systematics, parasitology, descriptive and experimental histology, cytology, descriptive and experimental embryology, chemical embryology, biochemistry, chemistry and biology of fertilization, physiology of the nervous system, sex problems, invertebrate endocrinology, radioactive isotopes, etc. Some laboratories, e.g. the Wenner-Grens Institut Stockholm (director, Prof. John Runnström) have sent to Naples an entire research staff to work on specific problems and to collect material to be studied at home.

The equipment of the station has improved considerably, but extremely specialized and expensive items such as ultracentrifuge, Tiselius electrophoresis, or Caspersson's U.V. apparatus, are lacking. Such apparatus as constant low temperature rooms, freeze-drying apparatus, ultrathermostats, photoelectric colorimeter, Geiger counter for radioactive isotopes, Beckman spectrophotometer, cathodic rays oscillograph, and phase contrast microscope have been secured.

The library is also in very good shape. The gaps in the files of journals have been almost entirely filled, and subscriptions are running regularly. This is most important, since so many biological laboratories in Europe have been destroyed. The collection of reprints is also increasing greatly. All biologists are urged to send their reprints regularly to the Library of the Zoological Station. The papers will become known to a wide circle of scientists. Many students are attracted not only by its laboratories and working possibilities, but also by its library.

It would be impossible to mention here all the people and organizations who have helped and are still helping the institution towards its rehabilitation. The cooperation of these friends from all over the world has been the directorial staff's greatest reward.

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Oxidation vs. Reduction of an α-Amino Acid

In a recent paper in *Science* (1949, **109**, 547) Schönberg and Moubasher proposed to connect the bacteriostatic or spermatocidal actions of substances related to benzil, of quinones, of triphenylcarbinol, etc. to their abilities to "reduce" α-amino acids. As illustrative of this process of "reduction" of an α-amino acid, these authors gave the equation,

$$\text{“}(C_6H_5)_3COH + R{-}\underset{NH_2}{\overset{H}{C}}{-}COOH \rightarrow (C_6H_5)_3CH + RCHO + NH_3 + CO_2\text{”}$$

In order to prevent further confusion in the chemical literature, I should like to point out that this process represents the oxidation (and not the reduction) of an α-amino acid. This conclusion is immediately apparent if (a) one observes that the triphenylcarbinol provides oxygen to the amino acid and is thereby itself reduced to triphenylmethane or (b) one compares the amino acid with its degradation products via the formal representation,

$$R{-}\underset{NH_2}{\overset{H}{C}}{-}COOH \xrightarrow[-NH_3]{+H_2O} R{-}\underset{OH}{\overset{H}{C}}{-}COOH \xrightarrow{-CO_2} RCH_2OH \xrightarrow{-2H} RCHO$$

in which one of the steps is seen to involve dehydrogenation, i.e., oxidation. It is, moreover, difficult to visualize how benzils or quinones could readily function as reducing agents rather than oxidizing agents.

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Book Reviews

Traité de Zoologie: Anatomie, Systématique, Biologie: Échinodermes, Stomocordés, Procordés. (Tome XI.) Pierre-P. Grassé. (Ed.) P. Brien, M. Caullery, L. Cuénot, A. Dalcq, C. Dawydoff, P. Drach, H. Harant, and G. Waterlot. (Contribs.) Paris (VI): Masson et Cie., 1948. Pp. 1077. (Illustrated.) 3800 fr.

There is always a need, in every branch of science, for up-to-date, authoritative, and comprehensive summaries of knowledge. In the field of descriptive zoology the wealth of new information that was amassed at the turn of the century made the task of compiling such treatises a difficult one, because they frequently became outdated before they were finished. In recent years, since the majority of zoologists have turned their attention towards experimental studies, the time has been better suited to the preparation of such works, which may now be written with reasonable assurance that they will remain useful for many years before extensive revision becomes necessary.

The publication of Miss Hyman's *The invertebrates: protozoa through ctenophora* in 1940 was an event of importance. It was the first attempt in the English language to summarize the existing knowledge of the invertebrates since the unfinished work of Lankester some forty years before. The publication under review is of similar importance, and serves to replace and extend such works as Delage and Herouard's *Traité de zoologie concrète* (1896–1903).

Tome XI is the first of a total of seventeen volumes planned for the series, which will cover the entire animal kingdom. The eight contributors are well chosen for the sections assigned to them and are known for their original contributions to the groups of animals concerned. The entire work is to be shared among a distinguished body of about eighty authors.

Illustrations are adequate in number and in clarity, being, for the most part, original or redrawn from original sources. In spite of the difficulties inherent in this type of collaboration, the editor is to be congratulated upon the consistency of style, and the authors upon the clarity of language. It is a pity that the arrangement of material within each phylum varies somewhat with the different authors. The use of the word *Stomocordés* in place of *Hémicordés* is an example of several innovations that may not receive universal approval, but these minor criticisms are far outweighed by the general excellence of the book.

Further volumes due to appear in 1949 are Tome VI (Onychophores, Tardigrades, Arthropodes: généralités, Trilobitomorphes, Chélicérates), Tomes IX and X (Insectes) and Tome XII (Vertébrés: généralités). These and further volumes will be awaited with interest.

F. G. Walton Smith
Marine Laboratory, University of Miami

Aviation medicine in its preventive aspects: an historical survey. John F. Fulton, London-New York: Oxford Univ. Press, 1948. Pp. viii + 174. (Illustrated.) $3.50.

A series of lectures delivered by the author at the London School of Hygiene and Tropical Medicine in 1947 provide the substance of this book. Dr. Fulton's long and intimate association with the field and his broad experience are reflected in the informative and authoritative contents. His scholarly style appeals alike to the initiate and to the layman.

The title is hardly specific. For aviation medicine has been, all along, a thoroughly practical branch of applied medicine and physiology and, as such, has always stressed the preventive aspects. The subtitle is more indicative of the subject matter. It is the author's labors in tracing the beginnings of aviation medicine back to Hooke, Boyle, Priestley, Lavoisier, Bert, and others of the 17th, 18th, and 19th centuries and even farther back, with accounts of early animal experiments and observations on humans in mountain climbing and balloon ascents, that will make the book particularly interesting and valuable to workers in the field.

The first three chapters are devoted to effects of abnormal barometric pressure—the first to anoxia, the second to effects of reduced pressure *per se* (bends, chokes), and the third to very rapid reductions of pressure (explosive decompression). The first two subjects are developed historically; the third was evidently not considered by early investigators. The rich opportunity for discussing preventive aspects, particularly in the first chapter, are not exploited, no mention being made, for example, of the long series of basic respiratory studies conducted in the U. S. Air Force laboratories that resulted in successful preventive techniques for altitudes to 40,000 feet and above. There is also no mention, except in the references, of the explosive decompression studies of Major H. M. Sweeney, whose name will always be associated prominently with this subject by his co-workers.

The fourth chapter gives a good, brief account of the physiological effect of acceleration. The important case of acceleration, too brief to produce displacement of blood (as in ejection seats, etc.), is not discussed. It is gratifying to note that the studies of RAF Wing Commander W. K. Stewart, which preceded all the U. S. centrifuge experiments, are given full recognition.

The fifth and final chapter is devoted to problems of crash injury.

In a dissertation which manages to have its say in a modest 170 pages, some omissions are unavoidable. By no means all of the important omissions, however, are alluded to in the preface, so that the uninitiated reader may receive a less than well-balanced impression of the subject. Of the three broad classical fields of investigation in aviation medicine—extremes of temperature, low

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barometric pressure, and acceleration—the first is not even mentioned, in spite of the fact that it has always been a major concern of aviation physiologists. Night vision, pilot training, and sanitation are mentioned in the preface as important omitted topics. To this list might have been added: numerous other vision problems, human sizing problems in the design of aircraft, controls, and clothing, medical problems caused by noise and vibrations, and the whole broad field of the psychology of flight.

There are few errors for a first edition. On page 61, there is an obvious confusion of absolute and gauge pressures, and on page 123, centripetal and centrifugal forces are respectively correlated, erroneously, with footward and headward forces. On page 124, the starting acceleration of the German V-2 rocket is given as 20 to 40 *G*. Actually, the acceleration is maximum when the fuel is nearly exhausted and does not exceed 8 *G*.

Carefully selected references add to the value of the book, but even here certain omissions are obvious. There is, for example, not one reference, on the subject of acceleration, to the important work of the Aero Medical Laboratory group.

With due regard for the fact that, as the author points out in the preface, the book is an account mainly of his own fields of interest and experience, it may be highly recommended to aeromedical specialists because of its historical perspective, and to the layman as an authoritative and easily read introduction to certain parts of the subject.

VICTOR GUILLEMIN, JR.

Aeromedical and Physical Environment Laboratory
University of Illinois

Syphilis: its course and management. Evan W. Thomas. New York: Macmillan, 1949. Pp. xix + 317. (Illustrated.) $5.50.

In both theory and application, the treatment of syphilis has undergone revolutionary change in the past fifteen years, leaving the subject in great need of adequate summarization—a service that is well done in this book by Thomas, who is eminently qualified by virtue of sustained interest and exceptional clinical experience in syphilis. In a field where few fixed judgments are yet justified, Thomas has freely expressed personal opinions, distinguishing clearly between those based on demonstrable facts and those derived from clinical impressions. While therapy is emphasized, the author also discusses the disease's course and clinical features, clearly but briefly—especially in the case of cutaneous and mucosal changes, where he merely points out the adequacy of previous descriptions and the obvious change in type of clinical material seen today in contrast with a few years ago. In spite of its brevity, the book should be adequate for the nonphysician interested in syphilis and for the medical student who has opportunity to learn from observation of clinical material. It will be particularly helpful to general practitioners, and to specialists in training or in practice in the many communities where the incidence of syphilis has decreased so much that it is difficult to arrive at definite conclusions regarding the newer therapeutic modalities. A chapter by Theo. J. Bauer reviews the public health aspects of syphilis.

All phases of syphilis are given consideration, but there is particular value in the discussion of interpreting serologic reactions, with emphasis on quantitative studies, and of neurosyphilis, with emphasis on the Dattner-Thomas concept and the need for repeated examinations of the spinal fluid. With reference to therapy, there is almost complete dependence on penicillin and the author attempts to provide the best available schedules for various clinical and serologic stages of the disease.

Minor criticism might be directed toward the too-brief discussion of the treatment of persons having what are presumably infectious contacts and of congenitally syphilitic women who are pregnant. The relation and association of cancer and syphilis are also treated too briefly, and the use of the term "syphilitic virus" is questionable. In view of Dr. Thomas' attempt at brevity, the space given to reports of individual patients seems unwarranted. The number of radiographic reproductions is greater than is justified by their inferior quality.

FRANCIS W. LYNCH

University of Minnesota

Physics: principles and applications. Henry Margenau, William W. Watson, and Carol G. Montgomery. New York: McGraw-Hill, 1949. Pp. x + 760. (Illustrated.) $5.00.

This book has been written to serve as a textbook in a general physics course for sophomore engineering students and natural science majors. A rigorous treatment is presented, with the aim of giving the student a sound basic knowledge of physics that will be adequate for further work in pure or applied physics. The authors assume that the student has a good working knowledge of algebra, trigonometry, and analytic geometry and some idea of the principles of calculus and that he is carrying on further study of calculus concurrently with the physics course.

The rigorous, mature, and stimulating approach to general physics encountered in this text makes it highly suitable for student groups having adequate mathematical preparation and a professional interest in physics. The text is extensive; the authors estimate that they have included enough material for a three-semester course of four or five credit hours per semester. To assist the instructor in choosing material for the usual two-semester course of four or five credit hours per semester, certain sections are starred, to indicate that they may be omitted without interrupting the logical development of the subject or omitting concepts necessary for understanding later sections.

Each chapter contains solutions of well-chosen illustrative examples and is followed by a group of problems for the student to solve. Very few problems can be solved by "substitution in formula"; they demand an understanding of principles and many problems are sufficiently difficult to demand effort from good students.

The text material is organized into sections on mechanics, heat, electricity, sound and light, and modern

physics. All frequently used systems of units are introduced with careful explanations, in the hope that the student will be able to work with British and metric gravitational units and British, cgs, and mks absolute units.

VIVIAN A. JOHNSON

Purdue University

Historical geo'ogy. Carl O. Dunbar. New York: John Wiley; London: Chapman & Hall, 1949. Pp. xii + 567. (Illustrated.) $5.00.

This book is the successor to the authoritative and successful *Historical geology,* first published by Charles Schuchert in 1915, revised by Schuchert in 1924, and authored jointly by Schuchert and Dunbar in 1933 and 1941. Each edition has been considered the authoritative text on the stratigraphy and paleontology of North America, and was preeminent in the paleogeography of North America, in which subject Charles Schuchert was the world's foremost authority for over thirty years. Invaluable as the paleogeographic maps were, it is rather odd that their importance in size and precision declined through the four editions.

Dunbar's *Historical geology* follows the plan, the substance, and most of the illustrations of the previous editions. An attempt has been made to popularize the text by more general treatment of stratigraphic and biologic facts, by omitting all but one of the stratigraphic correlation tables, and by including many large illustrations which cover from a quarter to half a page. The paleogeographic maps, which in previous editions were the authors' main original contribution to historical geology, have been reduced in effectiveness by purposely obscuring the boundaries of the continent and the limits of the seas by cloud effects, in order to emphasize the lack of knowledge about ancient seas and lands. The chapter on the origin of the earth might well have been reduced in length, for all of the hypotheses discussed are confusing and lack conviction, and are skipped as worthless by many instructors.

Whereas the book has been made more attractive by the emphasis on illustrations, and more readable by being less technical, it has lost a good deal of value as a text and a book of reference by omission of correlation tables, and by the obscuring of the paleogeographic maps. Nevertheless, it is likely to continue to be one of the leading textbooks in historical geology.

J. J. GALLOWAY

Indiana University

Scientific Book Register

ANDERSON, EDGAR. *Introgressive hybridization.* (Wiley Biological Research Series.) New York: John Wiley, 1949. Pp. ix + 109. (Illustrated.) $3.00.

BACHOFEN-ECHT, ADOLF. *Der Bernstein und seine Einschlusse.* Vienna, Austria: Springer-Verlag, 1949. Pp. 204. (Illustrated.) $4.80.

BLOM, A. V. *Organic coatings in theory and practice.* New York: Elsevier, 1949. Pp. xi + 298. $6.00.

CANNON, DOROTHY F. *Explorer of the human brain: the life of Santiago Ramón y Cajal.* New York: Henry Schuman, 1949. Pp. xv + 303. (Illustrated.) $4.00.

CANNON, WALTER B. and ROSENBLUETH, ARTURO. *The supersensitivity of denervated structures: a law of denervation.* (Experimental Biology Monographs.) New York: Macmillan, 1949. Pp. x + 245. (Illustrated.) $5.50.

CORLISS, JOHN J., FEINSTEIN, IRWIN K., and LEVIN, HOWARD S. *Analytic geometry.* New York: Harper, 1949. Pp. xi + 370. (Illustrated.) $3.25.

DANTCHAKOFF, VERA. *Le Sexe: Rôle de l'hérédité et des hormones dans sa réalisation.* Paris: Presses Universitaires de France, 1949. Pp. 210. (Illustrated.) 480 fr.

EMMONS, WILLIAM H. *et al. Geology: principles and processes.* (3rd ed.) New York: McGraw-Hill, 1949. Pp. x + 502. (Illustrated.) $4.50.

FAIRHALL, LAWRENCE T. *Industrial toxicology.* Baltimore: Williams & Wilkins, 1949. Pp. xi + 483. $6.00.

GREEN, HENRY. *Industrial rheology and rheological structures.* New York: John Wiley, 1949. Pp. xii + 311. (Illustrated.) $5.50.

LEROY, L. W., and CRAIN, HARRY M. (Eds.) *Subsurface geologic methods: a symposium.* Golden, Colo.: Dept. of Publ., Colorado School of Mines, 1949. Pp. 826. (Illustrated.) $6.00 paper; $7.00 cloth binding.

LICHTENSTEIN, BEN W. *A textbook of neuropathology: with clinical, anatomical and technical supplements.* Philadelphia: W. B. Saunders, 1949. Pp. xviii + 474. (Illustrated.) $9.50.

MOLDENKE, HAROLD N. *American wild flowers.* New York: D. Van Nostrand, 1949. Pp. xxv + 453. (Illustrated.) $6.95.

CLIPHANT, M. L. *et al. The atomic age.* (Sir Halley Stewart Lectures, 1948). New York: Macmillan; London: Allen and Unwin, 1949. Pp. 149. $2.50.

REDDICK, HARRY W. *Differential equations.* (2nd ed.) New York: John Wiley, 1949. Pp. x + 288. $3.00.

ROTHMANN, S. C. (Ed.) *Construction uses of atomic energy.* New York: Harper, 1949. Pp. vi + 258. (Illustrated.) $3.00.

SCHWEITZER, GEO. K., and WHITNEY, IRA B. *Radioactive tracer techniques.* New York: D. Van Nostrand, 1949. Pp. vi + 241. (Illustrated.) $3.25.

TAYLOR, LEWIS W. (Ed.) *Fertility and hatchability of chicken and turkey eggs.* New York: John Wiley, 1949. Pp. x + 423. (Illustrated.) $5.00.

TITUS, HARRY W. *The scientific feeding of chickens.* (2nd ed., rev.) Danville, Ill.: Interstate, 1949. Pp. 253.

TOBIN, CHARLES E. (Ed.) *Shearer's manual of human dissection.* (2nd ed.) Philadelphia: Blakiston, 1949. Pp. xv + 286. (Illustrated.) $4.50.

TUTIN, JOHN. (Ed.) *Atomic energy yearbook.* New York: Prentice-Hall, 1949. Pp. xvii + 237. (Illustrated.) $3.85.

UNDERWOOD, BENTON J. (Ed.) *Experimental psychology: an introduction.* New York: Appleton-Century-Crofts, 1949. Pp. vii + 638. (Illustrated.) $4.50.

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NEWS and Notes

Otto Warburg, for the past six months Special Research Fellow of the National Cancer Institute, returned to Berlin-Dahlen, Germany on September 8 to continue his directorship of the Kaiser Wilhelm Institute for Cell Physiology, established in 1931.

Charles Fore Wilkinson, Jr., associate director of the Division of Medicine of the Kellogg Foundation and assistant professor of medicine at the University of Michigan Medical School, has been appointed professor and chairman of the Department of Medicine of the Postgraduate Medical School, New York University-Bellevue Medical Center.

George A. Lundberg, head of the Department of Sociology at the University of Washington, is giving a series of lectures at the University of Stockholm during September and October. Dr. Lundberg's visit was arranged in cooperation with the Swedish Government Social Research Council. Upon completion of the series, he will lecture at the University of Oslo.

Perihan Cambel, formerly pathologist at the Gureba Hospital, Istanbul, and the Hygiene Institute, Ankara, has resigned his post at the Division of Cancer Research, Washington University, to become a special fellow and research associate professor at the Cancer Research Laboratory, University of Florida.

Max Astrachan, chairman of the Department of Mathematics, Antioch College, has been appointed professor and head of the Department of Statistics, U. S. Air Force Institute of Technology, Wright-Patterson Air Force Base, Dayton. Dr. Astrachan is on leave of absence from Antioch during 1949–50.

Hans Waine, physician and specialist in rheumatic diseases, has been appointed medical director of the New England Chapter of the Arthritis and Rheumatism Foundation, Boston. Dr. Waine will direct the foundation's activities in Massachusetts, Maine, New Hampshire, and Vermont.

Donald B. McMullen, associate professor of preventive medicine and public health, University of Oklahoma Medical School, has returned after 26 months' leave of absence. Dr. McMullen has been working on the epidemiology and control of schistosomiasis japonica in Tokyo, where he has been senior parasitologist with the 406th Medical General Laboratory.

Edwin St. Clair Gantz, associate professor of chemistry, Purdue University, has accepted a position as head of the Analytical Branch of the Chemistry Division, Research Department, at the Naval Ordnance Test Station, Inyokern, California.

Wendell W. Moyer, director of research at the Crown Zellerbach Corporation, Camas, Washington, has been placed in charge of the entire research and development activities of the company. **W. M. Hearon** has been appointed assistant director of research.

Edward Abrams, head of the Biology Division of the Institute of Textile Technology, Charlottesville, Virginia, and former head of the Microbiological and Microscopy Laboratories at the National Bureau of Standards, has established a new organization, Laboratories Research, at Mamaroneck, New York. Dr. Abrams will act as a consultant in the prevention of microbiological deterioration of organic and fibrous materials, stream pollution abatement, and general problems in bacteriology and biochemistry.

George W. Hartmann, Columbia University psychologist, has been appointed professor of psychology at Roosevelt College. Dr. Hartmann is the author of *Educational psychology* and *Gestalt psychology.*

Mr. and Mrs. Edward C. Rustigan are the parents of a baby girl, born September 17, 1949. Mrs. Rustigan is the former Mildred Atwood, who resigned as executive editor of *Science* in 1948.

Visitors to U. S.

Visitors at the National Bureau of Standards during the week of September 5 included **Matti U. Alhopuro,** metallurgical engineer, Autokumpu Copper Mines, Inc., Kumpu, Finland; **Pierre Chavance,** engineer with the Centre National d'Etudes et des Telecommunications, Neuilly, France; **Jean Combrisson,** engineer with École de Physique et Chimie, Paris; **Jacques Dedieu,** research metallurgist with École Centrale des Arts et Manufactures, Paris; **G. M. Gad,** Ceramics Division, Ministry of Industries, Egypt; **Paavo J. Kajanne,** research assistant, Finnish Institute of Technology, Department of Chemistry; **Delia H. Simpson,** professor of physics, Cambridge University; **Jacob Sklarewitz,** research worker, Hebrew Technical College, Haifa, Israel; **Adolf G. Smekal,** professor, Technical University at Darmstadt and member of German Society of Glass Technology; **Albert Sundren,** director of the Peat and Oil Research Laboratory of the State Institute for Technical Research, Helsinki; and **M. D. Waldhorn,** research worker with the Weismann Institute of Science, Rehovot, Israel.

F. C. William, consultant with the Manchester University, England, delivered a series of lectures on the cathode ray memory tube at the National Bureau of Standards Institute of Numerical Analysis at Los Angeles during the week of September 13.

Grants and Awards

The National Heart Institute has allocated $485,000 for heart research at New York University-Bellevue Medical Center. The fund will be devoted to the construction of laboratories and equipment for the center's Institute of Cardiovascular-Renal Disease. The institute's research program will be coordinated by the center's Scientific Committee on Cardiovascular-Renal Disease under the chairmanship of Homer W. Smith, physiologist.

The Howard N. Potts Medals of the Franklin Institute will be presented on October 19 to John W.

Mauchly, physicist, and J. Presper Eckert, Jr., electronic engineer, for their work in the design and construction of the digital electronic computing machine, ENIAC. The design for EDVAC, the electronic computer developed by the University of Pennsylvania, was also suggested by the two scientists.

Fellowships

The National Research Council of Canada will offer 31 postdoctorate fellowships for the year 1950–51, 18 of which will be awarded in chemistry, 3 in atomic energy research, and 10 in physics. The stipend of $2,820 per annum is supplemented by travel grants for successful candidates from abroad. While appointments in the atomic energy project are restricted to Canadian citizens and British subjects, applicants of all nationalities are welcome in the chemistry and physics divisions. Application forms and further information may be obtained from The Secretary, Laboratories Awards Committee, National Research Council, Ottawa. Applications should be received not later than *February 15, 1950*.

The School of Mathematics of the Institute for Advanced Study will allocate a small number of stipends to mathematicians and mathematical physicists for study and research at Princeton during the academic year 1950–51. Candidates must show ability in research comparable with that expected for the Ph.D. degree. Application blanks may be obtained from the School of Mathematics, Institute for Advanced Study, Princeton, N. J., and are returnable by *February 1, 1950*.

Colleges and Universities

Wayne University has received a grant of one million dollars from the Kresge Foundation to erect the Kresge Science Library which will house the university's Kresge-Hooker scientific collection, one of the most comprehensive chemical libraries in the world, as well as other science books and periodicals. There will be stack space for 50,000 science volumes and 800 science periodicals and future accessions; seminar rooms, a lecture hall, and a complete microfilm laboratory. It is expected that the library will be completed in 1951.

The Chemistry Department of the University of Notre Dame has announced its Nieuwland and Peter C. Reilly Lectures in Chemistry for the coming academic year. Eric K. Rideal, director of the Davy Faraday Research Laboratory, the Royal Institution, London, as Nieuwland lecturer, will talk on "Some Aspects of Surface Action," giving two lectures on liquid monolayers October 11 and two on solids October 13.

Lecturers for the Peter C. Reilly series are: Richard A. Ogg, Jr., of Stanford University, on leave as visiting lecturer at Harvard, who will talk on an unannounced topic during the week of October 31; Frederick D. Rossini, chief, Section on Thermochemistry and Hydrocarbons, National Bureau of Standards, who will deliver six lectures on "Chemical Thermodynamics and Purification of Hydrocarbons" during the two weeks beginning November 28; and V. Prelog, of the Eidge. Technische Hochschule, Zurich, who will visit the university for seven weeks beginning February 12, 1950, to discuss work in progress in his laboratories on "Ring Formation and Ring Properties," and various natural products.

The newly established New South Wales University of Technology, Sydney, Australia, is now offering undergraduate degrees in civil, electrical, mechanical, and mining engineering, applied chemistry, and chemical engineering, and graduate work in electronic engineering. Further degree courses will be established in 1950. The first university building is now being erected at Kensington. The following appointments to foundation chairs have already been made: chemical engineering, J. P. Baxter; mining engineering, D. W. Phillips; electrical engineering, H. J. Brown; architecture, F. E. Towndrow, and applied chemistry, A. E. Alexander.

Meetings and Elections

The American Psychological Association held its 1949 meeting in Denver, Colorado September 5–10. Morning and afternoon sessions were mainly devoted to research papers and symposia. These demonstrated the wide variety of research interests of psychologists, since they ranged in title over such topics as "Brain Functions," "Personality and Psychotherapy," and "Methodology in Social Psychology." The increased demand for psychologists and the necessity for training greater numbers of students to the Ph.D. level resulted also in many programs on the professional aspects of psychology.

Ernest R. Hilgard, of Stanford University, gave his presidential address on "Human Motives and the Concept of the Self." He suggested that psychologists begin formal research on the problems of personality and that one method of attaining this goal would be the establishment of "psychodynamic laboratories." There has been a lack of systematic treatment of psychodynamic problems, he stated, and "when there is no effort to be systematic, problems are not sharply defined."

Other evening addresses were delivered by Douglas McGregor, president of Antioch College, on "Labor-Management Relations: A Challenge to the Social Scientist," and William Menninger, past president of the American Psychiatric Association, on "Relations between Psychiatry and Clinical Psychology."

An innovation in the 1949 program was an evening free of formal sessions. About half of the 1,850 registrants took advantage of the opportunity to attend a buffalo barbecue at the Red Rocks Theater, in the Rockies a few miles west of Denver, during this time.

An award offered by an anonymous donor for the best paper published during 1948 in one of the association's journals was presented to L. L. Thurstone of the University of Chicago, for his paper in the *American Psychologist* entitled "Psychological Implications of Factor Analysis." Honorable mentions were given four papers by Thales Martins and J. R. Valle, Neal E. Miller, Edward C. Tolman, and Herman A. Witkin and Solomon E. Asch.

The annual Edward L. Bernays award was presented by Mr. Bernays

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to the Commission on Community Interrelations of the American Jewish Congress for their studies on bigotry. The award was accepted for the commission by Stuart W. Cook, director of research, and Alfred Marrow, chairman of the Research Board.

J. P. Guilford, of the University of California, is the new president of the American Psychological Association. Robert R. Sears, of Harvard University, was elected president-elect, and Dorothy Adkins, of the University of North Carolina, recording secretary. New members of the Board of Directors are John G. Darley, University of Minnesota; J. McV. Hunt, Institute of Welfare Research, Community Service Society of New York; and E. Lowell Kelly, University of Michigan. At the annual business meeting, the 1951 and 1952 meetings were scheduled for Chicago and Washington, D. C. respectively. Next year's meeting will be held on the campus of Pennsylvania State College September 3–9.

DAEL L. WOLFLE

It may truly be said that the science of biochemistry came of age when the **First International Congress of Biochemistry** met August 19–25 in Cambridge, England.

A year or two ago the Biochemical Society of England queried leading biochemists to obtain their reactions to the proposal to hold such a congress, and on the basis of response they decided to hold the congress in Cambridge under the presidency of A. C. Chibnall, F.R.S., professor of biochemistry of the university. An executive committee was set up and plans laid. By the summer it was clear that attendance would be large; it ultimately reached 1,750 individuals from 42 nations. There was a large and imposing American delegation and very large French and South American attendance. Scandinavia was also well represented.

As Cambridge has only five hotels, arrangements were made with the colleges for use of their rooms. We heard many comments on the spartan life of the undergraduates. Most participants, however, found their experience of student life at an old university interesting.

The opening ceremony, held in the historic Senate House where Winston Churchill was given an honorary degree, was packed, with many members standing. In the same hall, the degree of Doctor of Science *Honoris causa* was conferred on half a dozen of the world's leading biochemists including Carl Cori, Nobel Laureate and professor at Washington University. The old-fashioned ceremony, conducted entirely in Latin, preceded and followed by the Procession of Doctors through the town, will be long remembered by those privileged to see it.

After the degree ceremony there was a garden party in the grounds of St. John's College. The British Government invited all members to an evening reception on the grounds of Trinity College. It was also in the Great Hall of Trinity that the president's dinner was held for distinguished overseas members.

The 12 sections of the congress were in almost continuous session and over 500 papers were read and discussed. The highlights of the scientific meetings, however, were the three congress lectures. The first was given by C. T. Cori on "The influence of hormones on enzymatic reactions," the second by M. Florkin on "Biochemical aspects of some biological concepts," and the third by Sir Robert Robinson, also a Nobel Laureate, on "Tryptophan and its structural relatives."

At the formal closing session in the Senate House, the president thanked those who had worked so hard and the authorities of the university. He invited Sir Charles Harington, director of the National Institute for Medical Research and chairman of an *ad hoc* international committee, to report on the findings of the committee set up to consider the future of the congress.

The committee unanimously recommended that the Second International Congress of Biochemistry meet in Paris in 1952 at the invitation of the Société de Chimie Biologique and that immediate steps be taken to establish an International Union of Biochemistry under the wing of the International Council of Scientific Unions. Both these recommendations were passed.

The congress was privileged to witness a demonstration of Scottish sword dancing and reels to the music of Pipe-Major Robert Hill in his magnificent tartan and kilt.

FRANCIS J. GRIFFIN

Over 30 delegates from five foreign countries and the U. S. attended the **First International Sesame Conference** held at Clemson College, South Carolina, August 15–16.

A paper of preliminary work with sesame in El Salvador by Juan Cano, of Centro Nacional de Agronomia, was presented at the opening session by James Watkins, of the Office of Foreign Agricultural Relations mission in El Salvador who stated that sesame production in El Salvador has increased from 9,545 bushels in 1945 to 201,000 bushels in 1948. Much of the seed was exported last year to Italy and Austria under the Marshall Plan. The improvement of the sesame crop in India was discussed in a paper by N. Parthasarthy, head of the Division of Botany, Indian Agricultural Research Institute, New Delhi, presented by N. K. Sen, Division of Genetics of the University of California.

Significant advances in sesame breeding in Venezuela were reviewed by D. G. Langham, who discovered the first nonshattering sesame plant as a result of some of his crosses of breeding lines. Dr. Langham is head of the Department of Genetics and Agronomy of the Venezuelan Ministry of Agriculture.

J. A. Martin, host of the conference and an associate horticulturist of the South Carolina Experiment Station, reported on the breeding work now being done in his state. He has found that sesame is well adapted to the climate and soils of South Carolina and that high yields may be obtained by the use of certain varieties. Dr. Martin pointed out that the seed-shattering characteristic, the main obstacle to commercial production of the crop in this country, is being rapidly overcome.

Delegates were taken on a tour of the greenhouses and fields where sesame was in both the blooming and fruiting stages, and were shown the sesame introductions from foreign countries, breeding lines, yield tests,

irradiated lines, weed control experiments, and disease- and wilt-resistance studies.

Properties of a solvent-extracted sesame oil were discussed by K. S. Markley, head of the Oil, Fat, and Protein Division of the Southern Regional Research Laboratory, New Orleans, during the second session of the conference. A paper on the physical and chemical properties of the oils from varieties of sesame was prepared by Pierre Budowski and F. G. T. Menezes, of the Southern Regional Research Laboratory. Sesamol, a constituent of sesame oil, was explained by Dr. Budowski, who also described some of the research work now being done with sesame oil.

The nutritional value of sesame was discussed by Werner G. Jaffe, Sección de Quimica de Nutricion, of the Venezuelan Ministry of Agriculture. The nutritive value of tortillas and pancakes made of corn meal may be increased tremendously by using one part of sesame meal to nine parts of corn meal. Its vitamin values were discussed by E. J. Lease, nutritionist of the South Carolina Experiment Station.

It was pointed out during the meeting that expansion of the breeding program had been greatly facilitated by the research grants-in-aid or fellowships presented by the National Cottonseed Products Association to the Texas State Research Foundation, the North Carolina Experiment Station, and the South Carolina Experiment Station. The cooperative work of F. E. Johnstone, Jr., former chief agronomist of the National Cottonseed Products Association, and Lawrence C. Curtis, chief agronomist of the association, in obtaining seed stocks of various strains and in bringing in new literature on sesame was also commended by the conference. The need for further agricultural research was stressed, along with plant exploration in those countries where sesame has been grown for centuries, to seek superior germ plasm for new breeding lines.

At the final session the delegates accepted an invitation of the government of Venezuela to hold their next annual conference there. In 1950 conference delegates will be given the opportunity of seeing at first hand the research work now being performed by Dr. Langham.

HANS M. SIMONS, JR.

An international symposium on high altitude biology will take place in Lima, November 23–30, under the auspices of Unesco and the government of Peru. The Governing Council of the Institute of Andean Biology, headed by Carlos Monge M., has been appointed organizing committee of the symposium. Papers will be presented on circulation at rest and during physical activity; blood and respiratory characteristics at rest and during physical activity; nervous function; and endocrine factors and reproductions. Papers dealing with general or restricted aspects of the influence of a low environmental pressure on human and animal organisms will be considered by the committee and should be received not later than *October 15*. Hotel reservations should also be made before October 15. Address all communications to the Organizing Committee of the International Symposium on High Altitude Biology, Dr. Carlos Monge M., Director, Institute of Andean Biology, Lima, Peru.

The Tenth International Ornithological Congress, by invitation of the Swedish Ornithological Society, will be held at Upsala, Sweden from June 10 to 17, 1950. Attendance is open to persons of all countries interested in any phase of ornithology. According to the preliminary program the congress will convene in a general session on Saturday, June 10 at 2:00 p.m. Several excursions from Lund are planned for June 3–9, and others will leave from Upsala June 20–July 3. Alexander Wetmore, secretary, Smithsonian Institution, Washington, D. C., is president of the congress and Sven Hörstadius, Zoologiska Institutionen, Upsala, is secretary. Applications for registration should be addressed to the Tenth International Ornithological Congress, Upsala, Sweden, before *February 28, 1950*.

The Virginia Academy of Sciences elected the following officers for 1949–50 at its 27th annual meeting held in Richmond this spring: Boyd Harshbarger, president; Guy W. Horsley, president-elect; Foley Smith, secretary-treasurer; and E. C. L. Miller, secretary-treasurer emeritus. Ladley Husted and John N. Buck were elected to the council. The Academy voted to reestablish *The Virginia Journal of Science*, which was discontinued at the beginning of the war.

The American Neurological Association elected the following officers for 1949–50 at its 74th annual meeting held in June in Atlantic City: president, Henry W. Woltman; first vice president, Johannes M. Nielsen; second vice president, E. Jefferson Browder; secretary-treasurer, H. Houston Merritt; and assistant secretary, Charles Rupp.

Representatives of the atomic energy agencies of Canada, the United Kingdom, and the U. S. will hold their third declassification meeting September 26–28 at the Canadian Atomic Energy Research Establishment at Chalk River, Ontario. The uniform declassification guides, which the three nations now use in determining what information may be published, will be reviewed at the meeting in order to maintain maximum security of information held in common by the three nations. Senior reviewers for the U. S. AEC declassification system are: W. C. Johnson, chairman of the Department of Chemistry, University of Chicago; W. F. Libby, professor of chemistry, University of Chicago; J. M. B. Kellogg, leader, Physics Division, Los Alamos Scientific Laboratory; and R. L. Thornton, professor of physics, University of California.

The New York Academy of Medicine announces that the 1949–50 Laity Lectures will be held at the academy on the following dates: September 28: *Frontiers in Psychiatry*—Franz Alexander, director, Institute for Psychoanalysis, Chicago; October 26: *Methuselah—Myth or Promise*—David Seegal, professor of medicine, Long Island College of Medicine; November 16: *Frontiers*

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in Genetics—Laurence H. Snyder, dean of the Graduate College, University of Oklahoma; December 7: *Machines that Work Like Men*—John H. Gibbon, Jr., professor of surgery, Jefferson Medical College, Philadelphia; January 11: *The Biology of the Antibiotics*—Selman A. Waksman, professor of microbiology, Rutgers University; January 25: *Concepts and Methods of Medical Research*—Thomas M. Rivers, director, Hospital of the Rockefeller Institute for Medical Research. All lectures will be held at 8:30 p.m. The public is invited to attend, admission free. The lectures will be published by the Columbia University Press, New York 27.

A committee on research in anthropology has been formed by the Division of Anthropology and Psychology of the National Research Council and includes the following members: W. M. Krogman, chairman, Graduate School of Medicine, University of Pennsylvania; G. T. Bowles, NRC; W. W. Greulich, Stanford University; W. W. Howells, University of Wisconsin; F. E. Randall, Climatic Research Laboratory, Lawrence, Massachusetts; A. H. Schultz, Johns Hopkins University; H. L. Shapiro, American Museum of Natural History; T. Dale Stewart, U. S. National Museum; and S. L. Washburn, University of Chicago. The committee will serve as a clearinghouse for all research projects involving procedures and techniques of physical anthropology and in this sense will act as an advisory body. Suggestions or requests for advice or aid may be sent to the chairman.

The current ***Progress Report of Brookhaven National Laboratory*** (BNL-AS-2), which combines administrative and scientific progress, January 1 through June 30, 1949, is now available. Requests for this report should be directed to the Information Group, Information and Publications Division, Brookhaven National Laboratory.

Representatives from the anatomy departments of the nineteen veterinary schools in the U. S. and Canada met at the recent convention of the American Veterinary Medical Association at Detroit and formed an **American Association of Veterinary Anatomists.** The purpose of the association is to promote interest in the fields of teaching, research, and publication in veterinary anatomy. Officers of the group are: president, J. A. Grossman, Ohio State; president-elect, M. E. Miller, Cornell University; secretary-treasurer, J. F. Smithcors, Michigan State College.

The First Conference of Research and Development Groups of the Fifth Army Area was held at Fort Sheridan, Illinois, August 27–28. A series of seminars in the physical, biological, and medical sciences and engineering were attended by representatives of the Army's Logistics Division and six of its technical branches, and over 200 reserve officers from 19 research and development groups in the Fifth Army area. The reserve officers were Midwestern scientists representing university faculties, industrial research organizations, and research foundations. The conference was organized at the suggestion of Lars H. Sjodahl, commanding officer of the 5008th Research and Development Group of Chicago, and rheologist with the International Printing Ink Division of Interchemical Corporation.

Deaths

José de Carvajal-Forero, 51, X-ray expert, died August 3 in New York City. Dr. Carvajal-Forero was founder and first president of the New York X-ray Technological Society. He was well known for his technical advances in blue-tinting and work with barium.

Dennis R. Hoagland, 65, one of the country's leading plant physiologists, died September 5 at his home in Berkeley, California. Professor emeritus of plant nutrition and chemistry at the University of California, Dr. Hoagland had headed the university's Division of Plant Nutrition from 1921 until his retirement last June. In 1930 he received the Stephen Hales Prize of the American Society of Plant Physiologists and in 1941 was awarded the AAAS prize for a paper on nutriment solutions of plants, written jointly with Daniel I. Arnon.

Ralph R. Parker, 61, entomologist, died of a heart attack at his home in Hamilton, Montana, September 4. Director of the Rocky Mountain Laboratory of the National Institute of Health, Dr. Parker was co-discoverer of a vaccine for Rocky Mountain spotted fever.

Recently Received—

Etude des propriétés fondamentales des actinomètres by L. Bossy and R. Pastiels. (Memoires, Vol. XXIX. Verhand Elingen, Dl. XXIX). Institut Royal Météorologique de Belgique, Uccle, 3, Belgium.

Transactions of the Royal Society of South Africa, 1949. Copies obtainable from Hon. Secretary, Royal Society, University of Cape Town, Rondebosch, South Africa at 1£ 1s.

Marihuana in Latin America: The Threat It Constitutes by Pablo Osvaldo Wolff. Available from Washington Institute of Medicine, Washington 6, D. C. $1.50.

New Zealand Journal of Science and Technology, Index to Volumes 1 to 25, compiled by V. J. Wilson. (Council of Scientific and Industrial Research.) Direct inquiries to Govt. Printer, Wellington, New Zealand.

Make Plans for—

National Metal Congress and Exposition, 31st annual meeting, October 17–21, Public Auditorium, Cleveland Ohio.

American Oil Chemists' Society, fall meeting, October 31–November 2, Edgewater Beach Hotel, Chicago.

Pacific Chemical Exposition and Pacific Industrial Conferences, sponsored by the American Chemical Society, November 1–5, Civic Auditorium, San Francisco.